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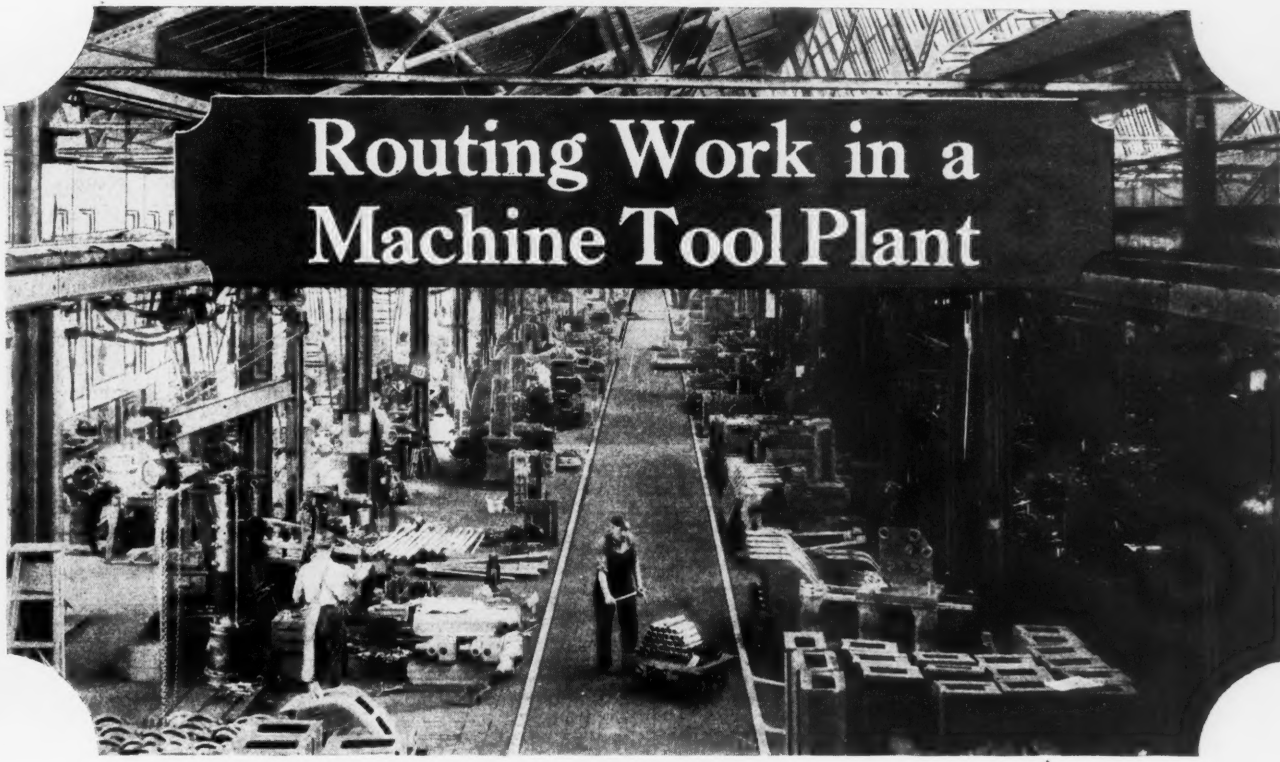


Routing Work in a Machine Tool Plant

Production System Adopted by a Machine Tool Builder After a Study of the Systems Employed in a Number of Shops

By ARTHUR L. BAKER, Production Manager, Baker Bros., Toledo, Ohio

SOME months ago it became apparent that a new system of routing parts through the shops of Baker Bros., Inc., would improve the efficiency of the plant. Before planning the new system, a study was made of the methods followed in several other machine tool building shops and in one automobile plant, and the valuable features were incorporated in a system that was applicable to the Baker Bros. shops. With the new system, work can be routed intelligently through the various departments, and an accurate record of costs maintained. Three men and one girl order all materials, and route and schedule the parts to the various departments; keep records of the time consumed in the different operations; estimate material, labor, and overhead costs of all parts; and maintain a record of the number of finished parts of each type in stock.

Stock List for Each Type and Size of Machine

When one or several machines of a type and size are to be built, a stock list, such as shown in Fig. 1, is made up for each unit as soon as a production order has been assigned. On this stock list are marked the job and drawing numbers of each part, the number of pieces of each kind required, the materials from which they are to be made, and the numbers of the departments to which each piece must be sent for machining. Even such small pieces as bolts, nuts, and cotter-pins, are entered on the stock list. Along the left-hand side of this list are five columns in which the time required for making each piece, and the labor, material, overhead, and total costs are entered when each job is completed, as will be explained later.

The stock list must be filled out by a man qualified to determine how each piece can be most economically finished and the sequence in which it should be routed to the various departments. The departments to which the pieces are routed are indicated by the numbers at the right of the stock list. Thus, for instance, the belt-shifter rod, Job No. 13135, is scheduled to be sent to departments 1, 6, 14, 18, 14, and 19. or the screw machine, drilling, stock, bench assembly, stock. and final assembly departments.

All stock lists for a given order are bound with a complete set of the blueprints required in finishing all parts for that order. One set of the lists and blueprints is kept in the office of the production manager, and another in the shop. The original stock list for a machine of a given size or type is made up on thin paper with India ink so that blueprints can be reproduced for similar machines at a future date. On these blueprints the columns reserved for time, labor, and material costs are printed white, as indicated in Fig. 1. The job number on the stock list and on all other forms illustrated, is also the pattern and blueprint number of the part.

Making out Routing Slips and Assigning Sequence Numbers

From the stock lists, pink and white slips of the form shown in Fig. 3, are filled out in duplicate, with the exception of the spaces reserved for recording the number of spoiled or defective pieces. These slips are filled out to route the work to the first department in which an operation is to be performed. When the work in the first department has been completed, similar routing slips are issued to cover the work to be done in the second department, and so on until the parts have been finished.

On the slips issued to the first department, the numbers of all the departments to which the work is to be sent are written on the bottom line near the left-hand side, so that the slips for all successive departments may be made out from the first. On the following routing slips, the numbers of the departments through which the work has already gone, are omitted. The department for which each routing slip is intended is marked in the space provided on the left-hand side of the slip, while the department to which the work is to be delivered next is marked in the space provided on the right-hand side of the slip.

On the right-hand side there will also be seen, for the two operations specified, the number 260, which indicates the sequence in which the work is to be performed in the department to which it is assigned. Every job has precedence over all others having higher sequence numbers, but it must not be machined until all parts with lower sequence numbers have been finished. The midway number is 250, and hence a job with sequence number 60 would probably be rushed through a department before all others. Repair parts are usually given 50 as the sequence number, and whenever a number lower than 50 is assigned, the work is so urgent that jobs in process on machines are taken out to make way for it.

Different parts for the same machine or for the same unit may be given different sequence numbers, because of less work being necessary on some parts than on others. For instance, a gear-case may be assigned sequence number 250, and the gears for the case, the sequence number 225. This use of sequence numbers provides a convenient means of putting jobs in process ahead of jobs ordered days ahead.

The sequence numbers are assigned five and ten numbers apart so that intermediate ones can be readily used.

Job Tag and "Material Required" Slip

When the first routing slip is made out, the job tag shown in Fig. 6 is also issued. This tag is fastened to one piece of the lot for which it is intended and goes with the job from the beginning to the end. It is made of green cardboard, and measures about 8 by 4 inches, exclusive of the stub, so that it is conspicuous. The stub is torn from the tag before the latter is actually sent into the shop, as will be explained.

If the green tag is intended for a casting, the "material required" slip shown in Fig. 4 is made out at the same time, clipped to the blueprint of the part and given to the "casting chaser," who issues an order on the foundry to cast the part. The "material required" slip is not used for parts other than castings, the first routing slip being used to draw bar and similar materials from stock.

Yellow job tags identical with that shown in Fig. 6 are used for repair parts. The different color insures that the parts to which such tags are attached will be noticed and put through the shop without delay.

Sending the Work to the First Machine Department

As the "material required" slip is sent to the foundry chaser, the green tag with the stub and the white and pink routing slips are fastened together and placed in a file according to the production number, and numerically according to the job number. They remain in the file until the castings for the job are delivered to the stock-room, where they are weighed. After the weight has been marked on the "material required" slip, the stock chaser returns this slip to the office of the production manager, removes the green tag and routing slips from the file, tears off the green stub and places it with the pink routing slip and the "material required" slip on a certain desk. He attaches the green tag to one of the castings in the lot by means of a wire, and delivers the white routing slip and the blueprint of the parts to the foreman of the department in which the first operation is to be carried out. The long tabular portion of the green tag is not filled out, as this has been found unnecessary.

The foreman decides what type of machine and which operators shall do the work on the parts, and then files the routing slip and blueprint with those of all other jobs routed to the same machine. The slips are filed according to the sequence numbers so as to insure that the urgent jobs will be assigned to the machines as they become idle. When a blueprint for a job is given to a machine operator, the routing slip is placed in a file marked "Work in Machines."

When the job has been completed, the machine operator returns the blueprint to the foreman, who then inspects the work and marks on the routing slip the number of parts passing inspection and the number of parts spoiled or found defective. He then signs his initials in the space provided, clips the routing slip to the blueprint, and instructs a truckman to deliver them with the work to the foreman of the next department marked on the routing slip. That foreman checks the number of castings delivered, and takes the routing slip to the production department, where another is made out specifying the work to be done in his department.

P.O. [redacted] DATE To Be Comp. Comp. AMT. [redacted] STOCK LIST OF BELT SHIFTER MACHS. No. 121 SP & QC DATE JAN. 5. 1924 SUPER'D BY SUPERCEDES LIST No. 10100

HOURS	LABOR	MAT.	OVHD.	TOTAL	JOB NO.	DRAW. NO.	REQ.	NAME	MAT.	R.S.	F.S.R.							
[redacted]					13135	13135	1	BELT SHIFTER ROD	CRS				1	6	19	18	19	19
					13136	13136	1	SPL. SHIFT. LEVER STUD	CRS					1	19	18	19	19
					13137	13137	2	SPL. PINS	CRS					16	19	18	19	19
					SP2606		2	1/16" COTTER PINS	-						19	18	19	19
					13016	13086	1	BRAKE SHOE						22	19	18	19	19
					T-13068	13068	1	BELT SHIFT. FINGER	C.I.				6	15	19	18	19	19
					SP2604		1	7/16"×1 1/4" HDL'S SET SCR							19	18	19	19
					SP1806		2	3/8"×2"-HEX. H'D SCR'S							19	18	19	19
							2	STD. 3/8" WASHERS							19	18	19	19
					14806	14806	1	SPRING-10-COILS	#13 WIRE						19	18	19	19
					14805	14805	1	SPRING PLUNGER	CRS					1	19	18	19	19
					18247	18247	1	BELL CRANK PIVOT PIN	CRS					1	19	18	19	19
					18251	18251	1	BELT SHIFTING POSITION RETAINING SPRING	SS						19	18	19	19
					18248	18248	1	PIN IN BELL CRANK 3 5/16" LONG	CRS			1	8	6	19	18	19	19
					SP1619		1	STD. 1/2" NUT							19	18	19	19
					18247½	18247½	1	WASHER						1	19	18	19	19
					18249	18249	1	PIN IN COVER-2 5/16	CRS			1	8	6	19	18	19	19
					SP3762		1	SPRING PIN	CRS					1	19	18	19	19
					13182	13182	1	BELT SHIFT. FINGER ROD	M.S.					16	19	18	19	19

Fig. 1. Typical Stock List, which is made up for Each Unit or Group of Parts into which All Standard Machines are divided

K.P. 1870-200 A COST RECORD BAKER BROTHERS, INC. TOLEDO.

DATE	MATERIAL KIND	MATERIAL WEIGHT	MATERIAL COST	HOURS PER PIECE	OVERHD PER HOUR	NUMBER OF PIECES	COST PER PIECE LABOR	COST PER PIECE MATERIAL	COST PER PIECE OVERHEAD	COST PER PIECE TOTAL	COST OF JOB	SPOILED	DEFECTIVE	PRODUCT ORDER
1921 10-31	C.I.	7	4 1/2	1	75	54	56	32	81	1 69	91.27			42
1922 10-28	"	7	5	1/2	1.00	91	32	35	58	1 25	113.72			198
1924 2-27	"	7	.06	5/16	1.00	172	43	42	84	1 69	291.09			220
8-1	"	7	.06	9/10	1.00	63	47	42	91	1 80	113.69	3	4	306

Fig. 2. Record kept on One Side of the Folded Cards filed in the "Kardex" Cabinet

Keeping Record of Costs and Amount of Stock on Hand

Each white routing slip returned to the production department is filed with the green stub, duplicate pink slip, and all preceding routing slips, so that there is always a complete record of the work done. When the parts reach the stockroom and have been checked, the blueprint is returned with the last routing slip, and all routing slips and the green stub are given to the timekeeper, who calculates the time required for doing the work and the labor, material, and overhead costs. This information is then recorded on the card shown in Fig. 2. This card is folded at the middle and kept in a "Kardex" file, such as shown in Fig. 7, in a manner that permits recording other information on the back. When open, the card measures 8 by 9 inches.

PART NO	PART NAME BELT SHIFTER				P.O. 306
JOB NO. 13068	MAT. C.I.	WT.	WT. PER PC.		REFER
DATE 7-14-24 ENTERED	DATE FINISHED	AMT. 70	TOTAL O. K. 63	DATE 7-27-24 INSP'TED	INSPECTOR R.C.A.
6 DEPT.	GOOD THIS COUNT	TOTAL 3 SPOILED	TOTAL 4 DEF'TIVE	NEXT DEPT. 63 COUNT	NEXT 15 DEPT.

OPERATIONS	JIG?	SPLD.	DFTVE.	MACH. NO.	SEQUENCE
DRILL	YES	3	4	115	260
SPOT FACE				115	260
15-14-18-14-19					

REMARKS	SET TIME	ACTUAL TIME
121	PREM.	GAIN LOSS

Fig. 3. Slip made out in Duplicate on White and Pink Forms to route the Work to the Various Departments

As shown in Fig. 5, the information recorded on the reverse side indicates the number of pieces of that particular kind sent from time to time to the stock-room, and the number withdrawn. With this record, it is always an easy matter to determine the number of pieces on hand. The job order number of the part is marked at the left-hand bottom corner, so that it is visible on each card filed in the drawer.

Near the bottom of the card is marked the maximum and minimum number of pieces that should be maintained in the stock-room, and when the number on hand gets below the minimum number, a green celluloid tab that is immediately visible as the file drawer is opened, is fastened to the card over number 1 on the bottom line. When parts have been ordered to meet the deficit, the tab is moved to number 2, and to each successive number as the operations are performed, being removed when the number of parts on hand exceeds the minimum limit. It is the practice to keep at least twenty-five small parts on hand for each standard machine, but large castings are made only as required. Whenever work runs low in the shop, the production manager can refer to the files, and by means of the green tabs, quickly decide on parts that should be ordered.

When the costs of an order exceed those of a preceding order for the same part, a red celluloid tab is attached to the card, and when they are lower than previous costs, a blue tab. In this way, the production manager can quickly decide what the tendency of the shop is, concerning costs.

These records are kept in four "Kardex" filing cabinets, mounted on rollers so that they can be conveniently pushed about the production office. With each of the double cards shown in Figs. 2 and 5, there is placed another card that gives details for each operation performed on the piece and the departments in which the operations are carried out. This card also contains such information as, in the case of gears, for instance, the diametral pitch and the number of teeth.

MATERIAL REQUIRED

AMOUNT 70

PAT. NO.	MAT. C.I.	P.O. 306
JOB NO. 13068	WT. 7	SEQ. 260

PART NAME BELT SHIFTER

MACHINE 121

DATE ORDERED 7-14-24

DATE RECEIVED 7-19-24

Fig. 4. Form used in ordering Castings from the Foundry

When all parts for one order have been finished, the production manager issues orders for assembling the parts into units and machines, and when these slips are returned to him, all costs marked on the cards in the "Kardex" files are copied on the stock lists described at the beginning of the article. These stock lists are filed permanently, and so it is easy to determine whether or not operations are exceeding past costs by referring to the stock lists of a previous machine.

Routing Parts for Special Machines

Special machines are not divided into units for routing through the shop, and neither is a stock list made up. However, all blueprints are bound together, a production number is issued for the machine and routing slips, and green tags are made out for the parts, as in the case of standard ma-

K.P. 1871-200 A FINISHED STOCK

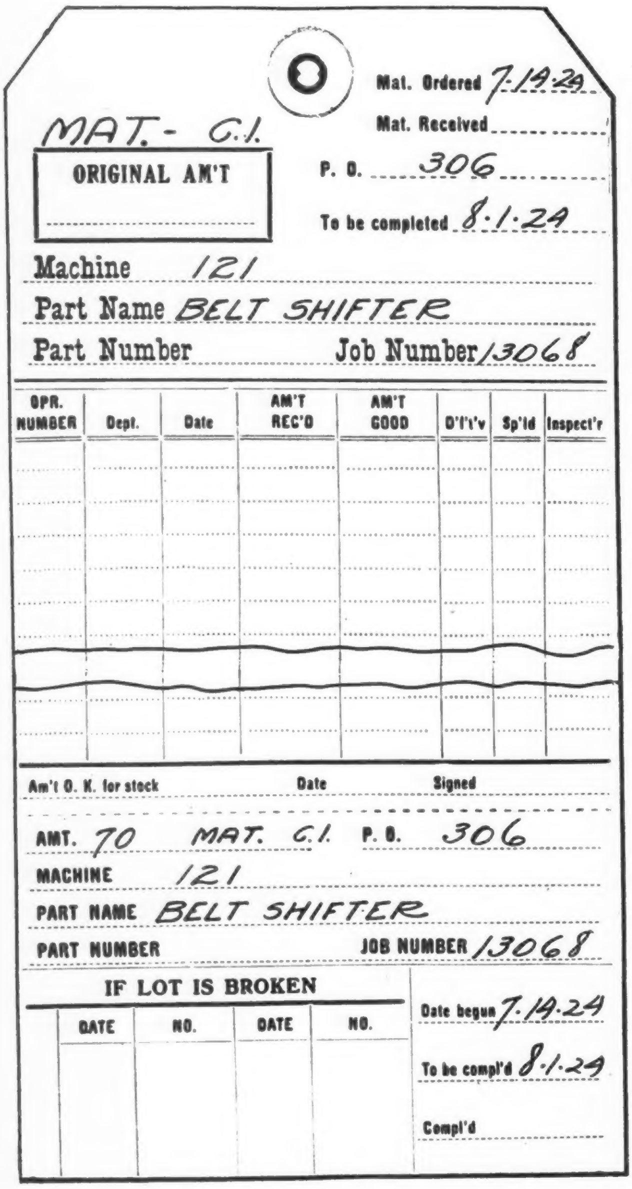
DATE	CHANGE	TOTAL	DATE	CHANGE	TOTAL	DATE	CHANGE	TOTAL	DATE	CHANGE	TOTAL	DATE	CHANGE	TOTAL
1924														
4-26	+9	9												
5-15	-1	8												
5-21	-1	7												
5-23	+3	10												
5-28	-1	9												
6-3	-1	8												
6-4	-1	7												
6-4	-1	6												
7-10	-5	1												
8-2	+63	64												
8-4	-6	58												
8-5	-1	57												
9-11	-1	56												
9-18	-1	55												
9-23	-2	53												
9-23	-2	51												

MAXIMUM 50 MINIMUM 25

JOB NO. STOCK LIST

13068 1 2 3 4 5 6

Fig. 5. Reverse Side of the Card illustrated in Fig. 2, which is used for recording the Amount of Finished Stock on Hand


MAT. - C.I.

ORIGINAL AM'T

Mat. Ordered 7-19-24

Mat. Received

P. O. 306

To be completed 8-1-24

Machine 121

Part Name BELT SHIFTER

Part Number Job Number 13068

OPR. NUMBER	Dept.	Date	AM'T REC'D	AM'T GOOD	D'l'v	Sp'ld	Inspect'r

Am't O. K. for stock Date Signed

AMT. 70 MAT. C.I. P. O. 306

MACHINE 121

PART NAME BELT SHIFTER

PART NUMBER JOB NUMBER 13068

IF LOT IS BROKEN

DATE	NO.	DATE	NO.

Date begun 7-19-24

To be compl'd 8-1-24

Compl'd

Fig. 6. Job Tag attached to Work as it is started through the Shop and carried with it until finished

chines. Instead of sending the parts for a special machine to the stock-room as they are finished, they are placed on shelves that can be transported about the shop as required. When all parts have been finished, they are taken together to the assembly department.

The production system here described proves satisfactory because it is easily manipulated. A complete stock of parts for standard machines is automatically assured by following up the green signals; by reference to the routing slips, the department in which a given lot of parts is can be quickly ascertained. If parts are spoiled, the routing slip shows which operator performed the work, and thus fixes the responsibility and gives a check on the skill of the men. If it is necessary to speed up certain parts, this can be done by merely lowering the sequence number. A further advantage of the system is that it insures prompt figuring of costs, because as soon as any part reaches the stock-room, the cost-keeper is presented with the routing slip, which shows that the work is completed; and finally, by compiling the costs for different lots of the same machine, a comparison may be made which gives an accurate indication of the trend of costs.

* * *

MACHINERY'S INDEX READY

The index to the thirty-first volume of MACHINERY, (September, 1924 to August, 1925) is ready for distribution, and will be sent to subscribers upon request.

TEST FOR WIRE ROPE

A test which could be applied to steel hoisting rope to show whether it is in safe condition or not, and which would not require the cutting of a sample from the rope, would be of great value. Every industry and operation which depends on wire rope for hoisting and haulage purposes is anxious to learn of some method by which the condition of ropes can be determined in service.

For some time the Bureau of Standards, Department of Commerce, has been investigating the possibility of applying some form of magnetic test to wire rope to determine its condition, as it is known that breaks in the individual wires, worn places, etc., as well as the stress on the rope, affect its magnetic permeability.

In order to design intelligently apparatus for the non-destructive testing of wire rope, it is necessary to know the nature and magnitude of the effects involved. One of the causes of deterioration of rope is wear, and the bureau has recently completed an investigation of the effect of wear on the magnetic properties and tensile strength of steel wire such as is used in the manufacture of wire rope.

The bureau found that wear increases the magnetic permeability for low magnetizing force, and decreases it for higher values; in other words, opposite readings are secured, depending on the magnetizing force employed. A load on the wire produces a similar effect, though it is much less in magnitude, and is probably caused by a redistribution of the internal stress in the wire. This change in magnetic properties is accompanied by an increase in the tensile strength. The complete results of this investigation are given in Scientific Paper No. 510 of the Bureau of Standards, copies of which can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

* * *

NEW OFFICERS OF SOCIETY OF INDUSTRIAL ENGINEERS

At the annual meeting of the Society of Industrial Engineers held in Detroit on September 29, the following officers were elected: President, Walter F. Rittman, Carnegie Institute of Technology, Pittsburg, Pa.; vice-president in charge of research, Perry A. Fellows, City Engineer, Detroit, Mich.; vice-president in charge of education, Charles B. Gordy, University of Michigan, Ann Arbor, Mich.; vice-president in charge of promotion, W. W. Nichols, D. P. Brown & Co., Detroit, Mich.; and treasurer, S. F. Mitzner, H. N. Stronck & Co., Chicago, Ill. George C. Dent, 608 S. Dearborn St., Chicago, Ill., was re-elected secretary.

Fig. 7. View of One of the "Kardex" Cabinets, which shows the Manner in which the Double Card illustrated in Fig. 2 and 5 is filed

JIGS AND FIXTURES FOR AUTOMOBILE ENGINE BLOCKS*

By J. G. MOOHL
Chief Tool Engineer, Cleveland Automobile Co., Cleveland, Ohio

In designing jigs and fixtures for large or medium production, there are several factors the tool engineer must consider, among the most important being accurate location of the work; firm but rapid clamping facilities and loading means; reduction of expense by similarity of patterns, bushings, and other parts; and the general design of the fixtures themselves. This article briefly describes how these points are carried out in machining engine blocks at the plant of the Cleveland Automobile Co., Cleveland, Ohio. In that organization it is considered that cooperation between the engineering department and the tool engineering department is of the utmost importance; and in line with that idea, it was decided that the tool engineer should determine the position of the locating points for the machining operations.

The first operation consists of milling the top, side, and bottom on an Ingersoll milling machine, for which the location of the work in the fixture must be made from cast surfaces. These surfaces are checked to a target fixture. In the second operation, two 3/4-inch locating holes in one side of the bottom flange are drilled with a combination drill and reamer. These two reamed holes are then used for locating purposes in every subsequent operation, and accumulation of errors is thus prevented. To insure long life and successful operation of the jigs, these holes must be large enough so that the locating pins and dowels may be of ample size to withstand wear and strains. Disappearing dowels are used throughout, so that loading may be accomplished by sliding the heavy casting in on hardened strips without lifting it over any protruding dowels or pins. The disappearing dowels, operated by a rack and pinion arrangement, work in standard interchangeable slip bushings of a type that is used in every possible application throughout the shop, over one thousand having already been put into use.

Means for Clamping Work in Fixture Rapidly

In determining upon the means of clamping and loading the work, the designer has a large variety of methods at his disposal, and to insure the best possible design he should consider a number of ways of accomplishing the same result and select the one most suitable for speed, safety, economy, and durability. A jig that is not quick-acting will usually prove to be a costly piece of equipment. The average reloading time for all jigs in the engine block department at the Cleveland Automobile Co. is twelve seconds. For heavy work, such as motor castings, if all obstructions that the piece would have to be lifted over are eliminated, and stops are used to locate it approximately, the loading time will be greatly reduced. Clamps operated by cams are in most cases the quickest and most satisfactory, except for milling operations, where something more solid must be used.

In order to equip the plant with jigs, tools, etc., for a limited expenditure of money, the tool engineer must resort to every available cost-reducing means. Much can be done right on the drawing board, and by adhering to certain principles of design, the cost can be reduced considerably without detracting from the usefulness of the tool. In general, a number of operations on the same piece may be performed with jigs having bodies cast from the same pattern. Since patterns represent a large part of the cost of a jig, much expense may be saved in this way. Frequently a whole series of jigs can be designed so that by changing a boss here and there, or perhaps adding a loose piece or two, one pattern serves for the bodies of all. Six jig bodies used in machining the "Cleveland Six" engine blocks were cast from the same pattern, and all along the line the different jigs have been kept as much alike in design as possible, the only difference in many cases being in the bushing plates.

*Paper presented before the Production Meeting of the Society of Automotive Engineers in Cleveland, September 16, 1925.

Appreciable expense is also saved by using in every possible case a single type of standard removable liner bushing. The bushings are generally the first part of the jig to need replacing, and those of a standard interchangeable liner type are easily obtained and replaced. To replace a drive fit bushing, the entire jig must usually be removed from the machine, taken to the tool-room, and at least partially dismantled, and a new bushing made to fit the hole. But a removable liner bushing, kept in stock in standard sizes, requires only that the machine be stopped a maximum of two or three minutes while the old one is lifted out and a new one slipped in without the aid of a single tool. The loss of time to the machine is, therefore, a matter of a few minutes, as against perhaps a half a day.

By using duplicate clamping parts, handles, knobs, screws, etc., on as many jigs as possible, not only will much time be saved in the drafting-room but also a smaller stock of replacement parts will be needed.

The Strength and Rigidity of a Fixture is of Prime Importance

In the general design of a fixture, the consideration of strength and rigidity must always be kept in mind. There is seldom any point in holding down weight, and the addition of 100 pounds of metal will cost only a few dollars and may save several hundred dollars worth of grief later. The base, or jig body, should be of heavy section and well ribbed, and it should be made as nearly as possible like a surface plate. This will leave little possibility of warping and throwing locating points or bushings out of line. Bushing plates should be designed with deep enough section or ribbing to prevent warping, and should have plenty of supporting length for the bushings. They should be so attached that there is no possible chance of their moving out of alignment. Sufficient chip clearance should be provided.

It is also important that all locating surfaces be self-cleaning. This must be accomplished in a variety of ways to suit the conditions, but in general, surfaces may be sloped away from horizontal locating points, so that chips will roll away. Vertical locating surfaces can usually be placed high enough above any horizontal surfaces so that chips will not accumulate in front of them. Wherever possible, openings should be provided in the wall of the fixture below these surfaces, to allow chips to fall out.

Cooperation between Engineering and Tool Departments

As an example of the extent to which cooperation between the engineering and tool engineering departments may be carried, the matter of boring cam and crank holes in the "Cleveland Six" engine block may be cited. This is a three-bearing job and, at the tool engineer's suggestion, the cam and crank bores were designed in steps, that is, starting at the front each successive bore is stepped up to a slightly larger diameter, and with this design a much more efficient method of boring is made possible. The work is done on a double-end machine with Kelly-type bars, two of which are long enough to reach the center cam and crank bearings. In the ends of these bars are sockets to take the shank of a core-drill the same diameter as the rough bore of the center bearing.

The successive cuts are as follows: The core-drill first cuts out the rear bore, followed by a fly cutter which rough-bores it to a larger diameter as the core-drill cuts the center hole. Meanwhile a similar core-drill cuts the front hole to its rough-bore diameter from the opposite end of the block. The fixture supports the bars in bushings, one outside of each end hole and one just back of the center. The bushing at the rear end is fitted with an inner bushing which is keyed to the bar and rotates with it. It is slotted for the passage of the Kelly cutter. This method, it is estimated, represents a saving in time of about 50 per cent over the usual way where all bores are of the same diameter and cutters must be removed from the bar and inserted again between the bores. The finish-boring is then done on a single-end machine with removable bars and fixed cutters.

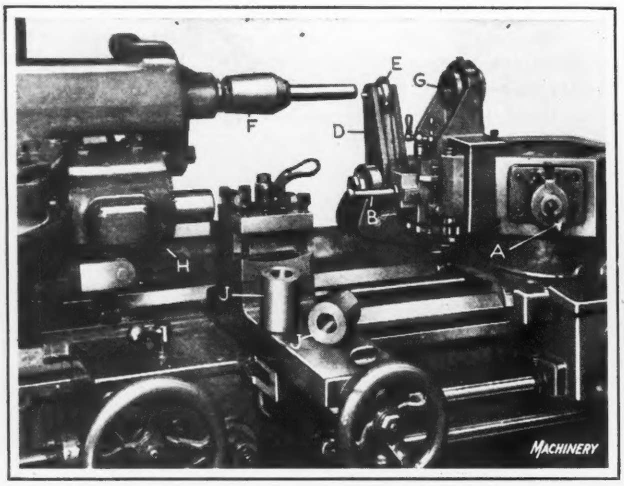


Fig. 1. Tooling Equipment employed in boring the Dies

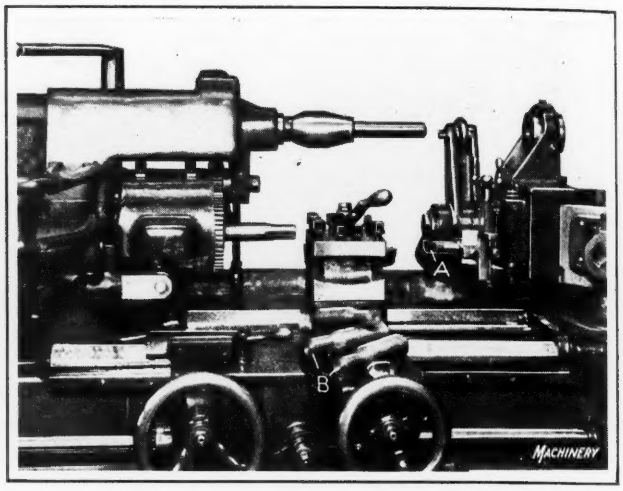


Fig. 2. Equipment used for turning the Punches

Elliptical Turret Lathe Operations

By CHARLES O. HERB

ELLIPTICAL turning and boring of high-speed steel punches and dies in quantities are being successfully accomplished in turret lathes by means of the tooling equipment shown in Figs. 1 and 2. At *B* in Fig. 3 it will be seen that the working end of the punch has the shape of an ellipse, 1 inch wide by 1 1/4 inches long, and is back-tapered 1 1/2 degrees on each side. From the drawing of the mating die shown at *A*, it will be noticed that the die affords a clearance of 1/32 inch all around the punch and that the hole is tapered 2 degrees on each side. In tooling up the machines for finishing these two parts, the elliptical shapes combined with the tapers presented an interesting problem. The machines and the tooling equipments were built by the Warner & Swasey Co., Cleveland, Ohio.

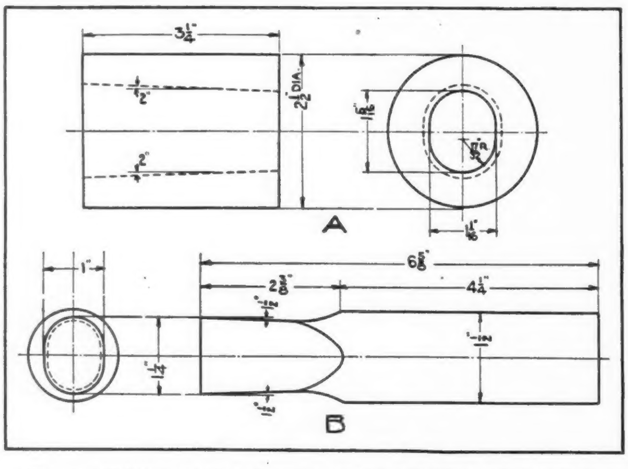


Fig. 3. Elliptical Shaped, Tapered Carbon Tool-Steel Punch and Die machined with the Equipment shown in Figs. 1 and 2

The tooling equipment used for boring the die is illustrated in Fig. 1. Drill *A* is first employed to drill a hole of about the diameter of the small end straight through the part, and then tool *B* is used for boring to the combined elliptical and tapered shape. Finally, tools on the square turret face the overhanging end of the die and cut the piece off. The stock is held by a standard automatic chuck.

To obtain the necessary movements of tool *B* for the elliptical and taper boring, the tool is mounted in a special unit *C*, Fig. 7, which is oscillated by arm *D*. Unit *C* and arm *D* are rocked back and forth about the same pivot by movements imparted to roll *E* as it is guided along the revolving cam *F* when the turret is fed toward the work. The tool is rocked in an arc instead of in and out or up and down. Cam *F* is both elliptical and tapered to produce the desired hole in the die. The pilot on the cam enters bushing *G*, thus steadying the cam during the contact of the roller. Gear *H* on the main spindle delivers power for driving the shaft on which the cam is mounted, at the same speed as the spindle rotation. Roll *E* is held in contact with the cam by a spring and also by the pressure of the cut. Tool *B* is mounted on a slide which is adjusted on unit *C* to suit different diameters of work, by turning the double-ended crank.

From Fig. 2 it will be seen that the operation of turning the punch is accomplished by using a mechanism identical

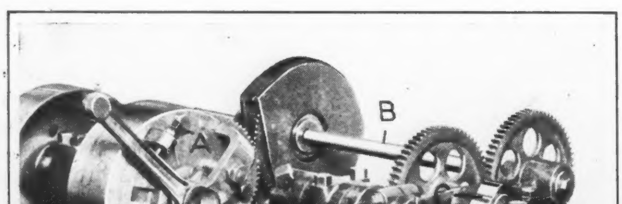


Fig. 4. Tooling developed for boring Automobile Connecting-rods elliptically

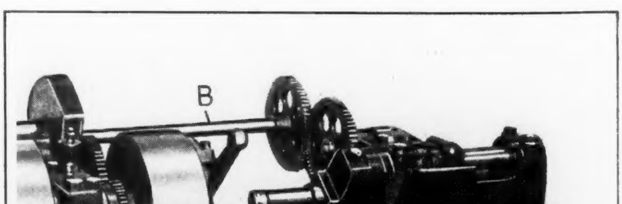


Fig. 5. Another View of the Tooling Equipment for boring Automobile Connecting-rods

to that used for boring the die, except that a gooseneck turning tool *A* replaces the boring tool. The production obtained in the boring operation averages four dies per hour, and in the turning operation, four and one-half punches per hour. Finished dies are shown at *J* in Fig. 1, and finished punches at *B* in Fig. 2.

Boring a Connecting-rod Bearing

Another elliptical boring operation performed in a turret lathe on which the turret has been replaced by a special slide, is illustrated in Figs. 4 and 5. The operation consists of boring the crankpin bearing hole of automobile connecting-rods. The purpose of the elliptical boring is to obtain a circular bearing in the connecting-rod when the latter is assembled on the crankshaft after the crankpin end of the rod has been split.

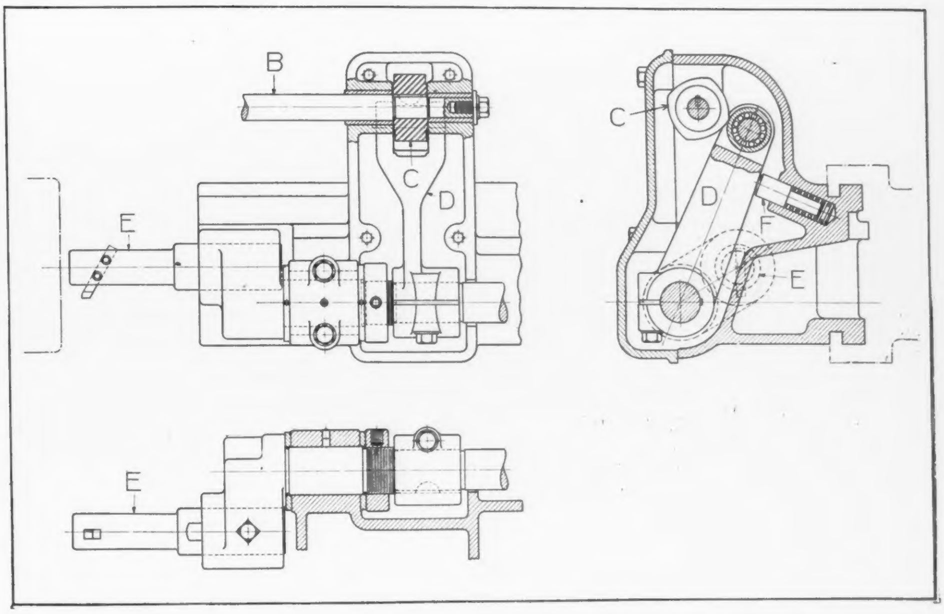


Fig. 6. Construction of the Boring Unit used for finishing the Crankpin Hole Bearing in Connecting-rods

To permit the piston-pin end of the connecting rod to swing over the bed of the machine, it was necessary to increase the height from the bed to the center of the spindle and of the boring tool, by the use of blocks. The crankpin bearing hole is centralized for the operation by seating the boss on one side of the hole in a ring on the face of the chuck and placing one side of the rod against screw *A*. Then clamps are tightened on the outside boss to hold the rod in place. Screw *A* serves to drive the rod when the chuck is revolved.

The boring tool mechanism constitutes the interesting feature of this tooling equipment because of the way in which it oscillates the boring tool to suit the hole being finished. Power for accomplishing the oscillation is delivered by shaft *B* and spur gears to cam *C*. This cam revolves against a roller held between the jaws of lever *D*, as shown in Fig. 6, and causes the lever to rock back and forth. The lever, in turn, oscillates the boring-tool holder *E* as required. The roller of lever *D* is held in contact with the cam by the spring-actuated plunger *F* and by the force exerted by the cutting operation.

COMMERCIAL AIRPLANE SERVICE

According to a report made jointly by the United States Department of Commerce and the American Engineering Council, airplanes in regular commercial service throughout the world have covered over 30,000,000 miles up to the present time. The accumulated experience from this past performance affords sufficient data for further developing reliable and safe commercial airplane service. It is only recently that commercial services of this type, except for carrying mails, have been inaugurated in the United States. At present the Ford Motor Co. flies airplanes daily between Detroit and Chicago, and Detroit and Cleveland.

* * *

After more than thirty years of operation, during recent years at the Page Belting Co. of Concord, N. H., the first multi-phase induction motor to be placed in commercial operation on a central station line in the country is to be retired from active service, and will be used by the General Electric Co., Schenectady, N. Y., as an historical exhibit. This motor was the first one sold of its type in 1893. It was rated 5 horsepower.

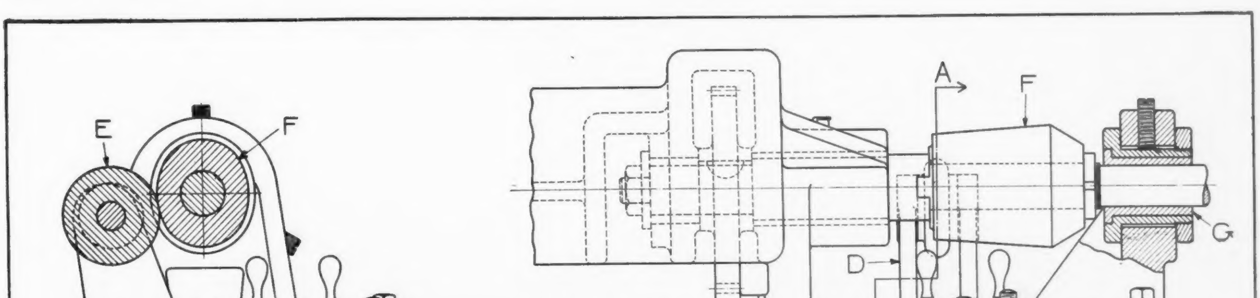


Fig. 7. Construction of the Mechanisms used in boring an Elliptical Tapered Hole and turning an Elliptical Tapered Punch

The Most Economical Number of Parts to Make at One Set-up

By JOHN M. CHRISTMAN

NEARLY all manufacturing concerns are confronted with the problem of how many parts of one kind should be made at one time before breaking down and resetting for another part. It is evident that the set-up cost per part is less as the number of parts in a run increases; therefore, if there are too few pieces in a run, the part becomes very costly. It is also evident that if too many pieces are made in a run, the pieces will be in storage a long time before they are used, causing the cost of the part to be increased due to interest on money invested in parts and storage space cost; therefore, too many pieces in a run will also make the parts very costly.

From the foregoing it can be seen that if too few or too many pieces are made in one run the parts become more costly. There is, however, one quantity where the sum of the set-up cost and the increased cost due to interest and floor space is a minimum, and this quantity is known as the "economical cycle." When you consider that only a few minutes are required to determine this quantity, it is very doubtful if anything saves a concern so much for so small an expenditure, as the calculation of this number.

By the use of higher mathematics it can be proved that the economical cycle equals

$$\sqrt{\frac{BFD \times 560}{C \times (D - F) \times A}}$$

In this formula,

B = total cost of set-up, in dollars;

F = number of parts used per day;

D = number of parts that can be made per day;

C = total cost of material, labor, and overhead per part; the set-up cost per part can be neglected at this point, as it would change the economical cycle but little.

A = fraction by which the cost of the part is increased if kept in storage for one year; this increase is caused by interest on money invested, insurance, and value of floor space. For example, assume that C equals \$0.25, the interest rate is 6 per cent, and insurance and floor space costs \$0.01 per part per year; then the cost of one part, if in storage one year, would be increased $0.25 \times 0.06 + 0.01 = 0.025$, which equals 10 per cent, or $A = 0.1$.

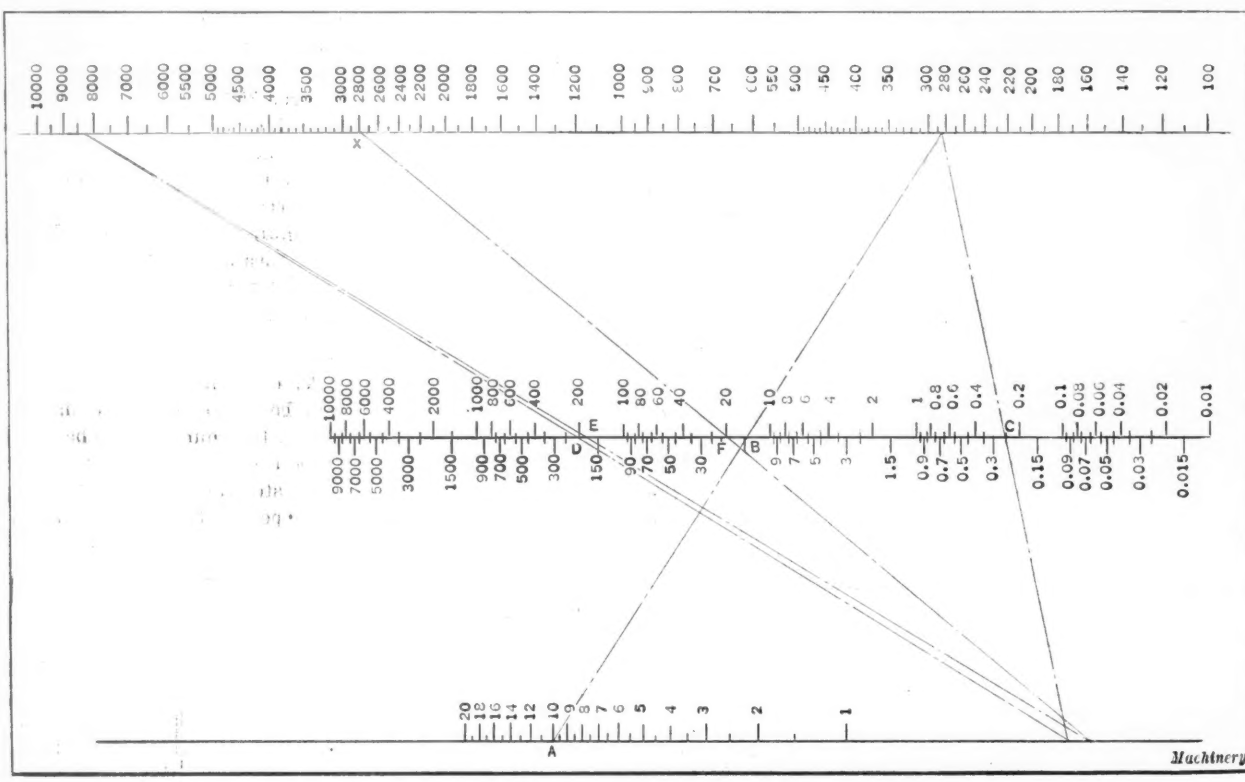


Chart for determining the Most Economical Number of Parts to make at One Set-up
A = per cent cost of part is increased per year due to interest and storage costs; B = total cost of set-up in dollars; C = cost of material, labor, and overhead per part in dollars; D = number of parts made per day; E = D — F = number of parts made per day minus the number of parts used per day; F = number of parts used per day; and X = the most economical number of parts to make at one set-up

For the purpose of explaining the use of the formula, assume that B = \$16, F = 20, D = 200, C = \$0.25 and A = 0.1 (10 per cent). Then

$$\sqrt{\frac{16 \times 20 \times 200 \times 560}{0.25 \times (200 - 20) \times 0.1}} = \sqrt{7{,}964{,}444} = 2822$$

or 2800 approximately

The use of this formula entails a rather lengthy calculation; therefore, the accompanying chart was made which works similarly to a slide-rule and requires the drawing of but a few lines to obtain the desired results.

To solve the problem previously presented by means of the chart, proceed as follows: Point off A (equal to 10 per cent) on the lower scale; draw a line from this point through point B (which is equal to 16) on the center scale

to a point on the upper scale; from this last point draw a line through C (equal to 0.25) on the center scale to the lower scale; then draw a line through D (which equals 200) on the center scale to the upper scale; next draw a line through E (which equals $D - F = 180$) on the center scale to the lower scale; and, finally, through F (which equals 20) on the center scale, draw a line to a point on the upper scale where a figure of approximately 2800 may be read off. Note that the various steps on the chart are alphabetically arranged.

The results read from the chart are, of course, approximate only, but this is quite satisfactory, because variations of 10 per cent either way make very little practical difference. In the problem considered, for example, it can be shown mathematically that the difference between the set-up cost per part and the storage cost per part varies but little from 2500 to 3100 pieces.

If the parts in the problem considered were made in lots of 2822 pieces, the set-up cost per part would be $16 \div 2822$ or \$0.0056. Since $\frac{2822}{20}$ days are required to use the parts in the cycle and since $\frac{2822}{200}$ days are required to make the parts, it is evident that the last part made would be in storage $\frac{2822}{20} - \frac{2822}{200}$ days. The first part made is in storage no time. Knowing the time the first and last parts are in storage, the average storage time can be obtained by taking one-half of the sum, thus: $\frac{1}{2}\left(\frac{2822}{20} - \frac{2822}{200}\right)$ days. Taking 280 as the number of production days per year, the average time would be $\frac{1/2}{280}\left(\frac{2822}{20} - \frac{2822}{200}\right)$ years.

Since the storage and interest increase the cost of the parts 10 per cent per year, the storage charge on the parts would be $0.25 \times 0.1 \times \frac{1/2}{280}\left(\frac{2822}{20} - \frac{2822}{200}\right)$ or \$0.0056 per part. It can be seen that the set-up cost, \$0.0056, and the storage charge, \$0.0056, are equal when the most economical number of parts are made. This can be proved mathematically, but requires a very complicated mathematical analysis. Assuming that this is true, however, the deriving of the formula is quite simple; thus

X = economical cycle;

$\frac{B}{X}$ = set-up cost per part;

$\frac{CA}{560}\left(\frac{X}{F} - \frac{X}{D}\right)$ = storage charge per part.

Then

$$\frac{B}{X} = \frac{CA}{560}\left(\frac{X}{F} - \frac{X}{D}\right)$$

from which

$$X = \sqrt{\frac{BFD \times 560}{C \times (D - F) \times A}}$$

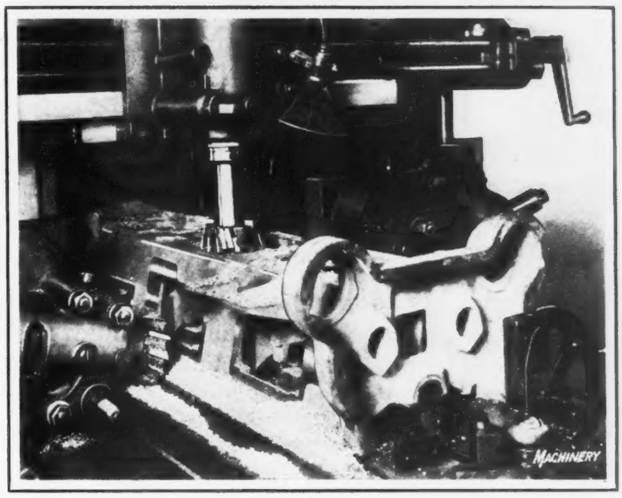
* * *

In advocating the use of speed governors on commercial motor vehicles before the New England section of the Society of Automotive Engineers, Edward F. Lowe, of New York, pointed out in an address that, according to a report by the National Automobile Chamber of Commerce, 40 per cent of the major fatalities in which motor vehicles were involved during the first seven months of last year were due to speeding, and that, while commercial vehicles constitute only 24 per cent of the motor vehicles registered in New York City, 53 per cent of the accidents in the city in 1924 were caused by commercial vehicles.

MILLING LARGE CRANKCASES

Three milling cutters are employed simultaneously at the plant of the Sterling Engine Co., Buffalo, N. Y., in finishing a motor-boat engine crankcase that is over 5 feet long. As may be seen from the illustration, the operation is performed on a planer-type milling machine. One cutter is mounted on the cross-rail tool-head, and one cutter on each side-head, the side-heads being swiveled 13 degrees from the horizontal. Finished surfaces of the casting seat directly on the table of the machine, and the half bearings are supported by accurate hardened and ground blocks. It would be impossible to provide work-holding fixtures for all the crankcases at the plant mentioned, because of the large range of sizes and designs made.

Cutters 6 inches in diameter are used for this operation, and it is necessary to feed them back and forth, sideways, or up and down. The use of cutters large enough to machine all surfaces at one pass of the work is impossible, due to the interference that would be caused by the different lugs. In machining the top surface, it is the practice first to feed the vertical head from left to right to machine the far end. Then the cutter is returned to the left-hand side and that side is finished as the work is fed past the cutter.



Milling a Large Crankcase by the Use of Three Cutter-heads

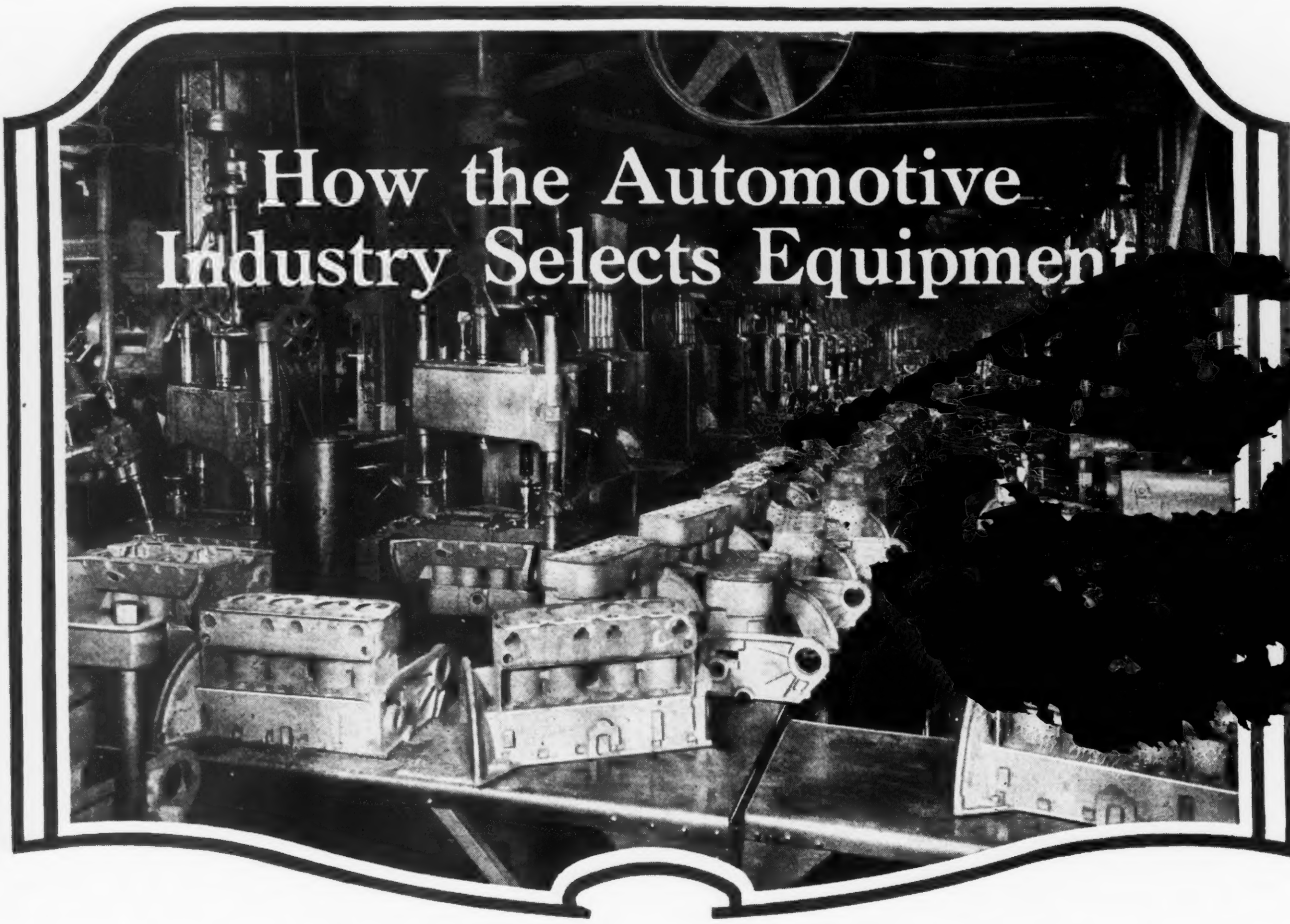
When the opposite end of the work reaches the cutter, the latter is fed across it, and then the right-hand side of the top is machined as the table is returned.

There are one or two pads higher than the major portion of the top surface that must also be finished, and the head is raised to the proper level for these pads. The side-heads must be operated somewhat similarly. Roughing and finishing cuts are taken on all surfaces, about 3/16 inch of stock being removed in the roughing, and 1/16 inch in the finishing. The different settings of the heads are accurately made by the application of hardened and ground steel blocks. The height of the crankcase must be true within plus or minus 0.003 inch.

* * *

As an example of the commercial value of weather forecasts in the industries, the following incident may be mentioned. A large concern using 27,000,000 gallons of lake water a day in operating steam turbines was frequently forced to shut down to avoid damage to its processes when the lake level occasionally fell below the water intake. Early this year the weather conditions indicated that there would be a sharp drop in the water level. The official in charge of the Weather Bureau Station notified the company at noon that the lake level would be likely to fall a foot or more during the afternoon. The fall was so rapid that considerable damage would have resulted if the plant had not been prepared to shut down before the shortage of water took place.

How the Automotive Industry Selects Equipment



Second of a Series of Three Articles Dealing with Important Factors Considered by Equipment Engineers in Selecting Machine Tools, Small Tools, and Tooling Equipment for the Production of Automobiles, Trucks, and Tractors

THE automotive industry is the largest single buyer of machine tools, and its requirements are unusually severe. Because of the importance of the point of view of the automotive equipment engineer, therefore, MACHINERY has obtained from production managers and other men responsible for the selection of machines and tools in a great number of important plants throughout the country, the ideas that guide them in the choice of efficient equipment. These opinions will be recorded in a series of three articles, of which the first was published in October MACHINERY.

In the October article it was pointed out that the production per day is the first consideration in the selection of automotive equipment. The advantages of standard and special machines for different purposes were compared; the problem of breakdowns was considered; and the general principles that guide the equipment engineer in selecting machine tools—the quality of the work required, the unit cost of work, the cost of maintenance, and ease of operation—were dealt with in considerable detail. The problems of the engine and parts manufacturer were given attention and the mechanical features that equipment engineers mainly look for were briefly outlined. Finally, the question "How long should it take the savings due to increased production to pay for a new machine?" was answered.

The present article will deal with the actual procedure in different plants in selecting new equipment, and will briefly outline what the equipment engineer looks for in various types of machine tools, as, for example, turning machines, milling machines, drilling machines, and grinding machines.

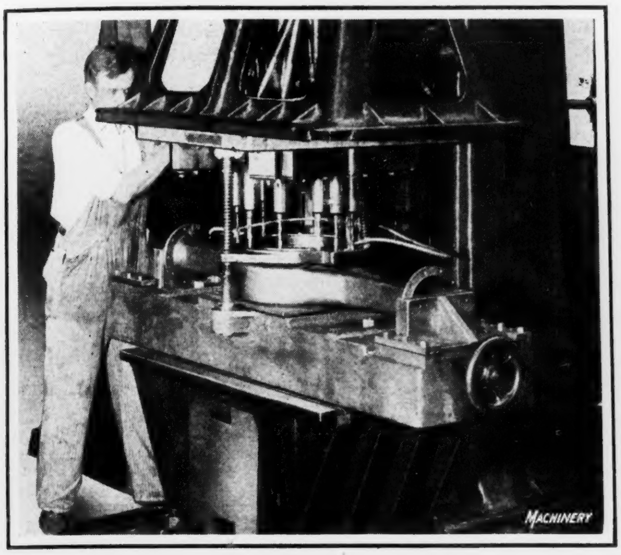
The third and concluding installment of this series will be published in December MACHINERY, and will deal with the selection of small tools—taps, drills, cutters, and reamers.

The actual methods used in selecting new equipment vary somewhat in different automobile plants. A brief outline of the methods employed in representative plants will be given in the following.

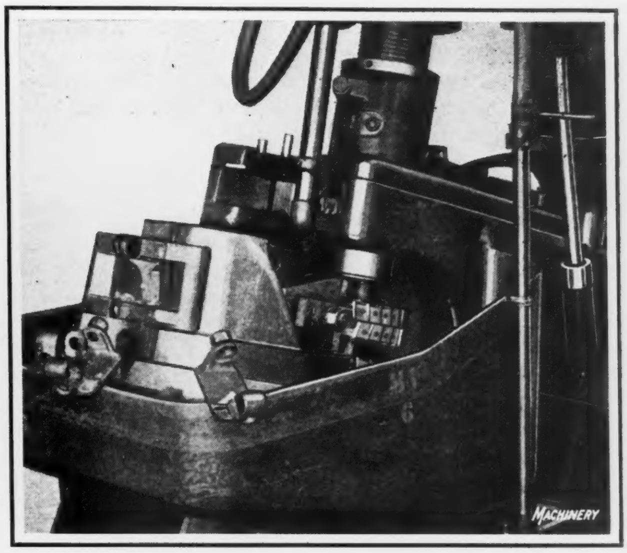
Procedure in Selecting New Equipment

In one plant, the equipment engineer studies every opportunity for increasing production or reducing cost that comes to his attention, either through his own observations or through suggestions from the production staff. He makes a thorough investigation, and after he has made up his own mind as to what equipment ought to be purchased, and formulated his reasons for the purchase, he reports to the works manager who signs the order for the equipment, after he has satisfied himself that the machines selected are the best for the purpose. The equipment engineer never recommends any equipment without first consulting the foreman of the department where the machines are to be used. He explains to the foreman the reasons why certain machines should be bought. Sometimes the foreman offers objections, and if these appear to be valid, the equipment engineer changes his recommendation.

In another plant, the mechanical superintendent's office investigates the value of new equipment, and after a thorough investigation, the details of which will be outlined later, makes a recommendation to an equipment committee consisting of the general superintendent, the purchasing agent, the superintendent of stores, and the chief metallurgist of the company. The investigation includes asking for bids and production estimates from machine tool builders. These estimates must give not only the estimated production, but the proposed speeds and feeds at which the machine will have to be operated. Sometimes it is found that the production estimates are based upon too high speeds and feeds. This would wear out the tool too quickly and increase the tool cost too much. Sometimes the estimates are too high for the capacity of the machine. Hence the production estimates are thoroughly checked before accepted.



Drilling Rear Axle Housings on a Multiple Drilling Machine at the General Motors Truck Co.'s Plant



Rough-milling Jaws on Steering Knuckles at the General Motors Truck Co.'s Plant

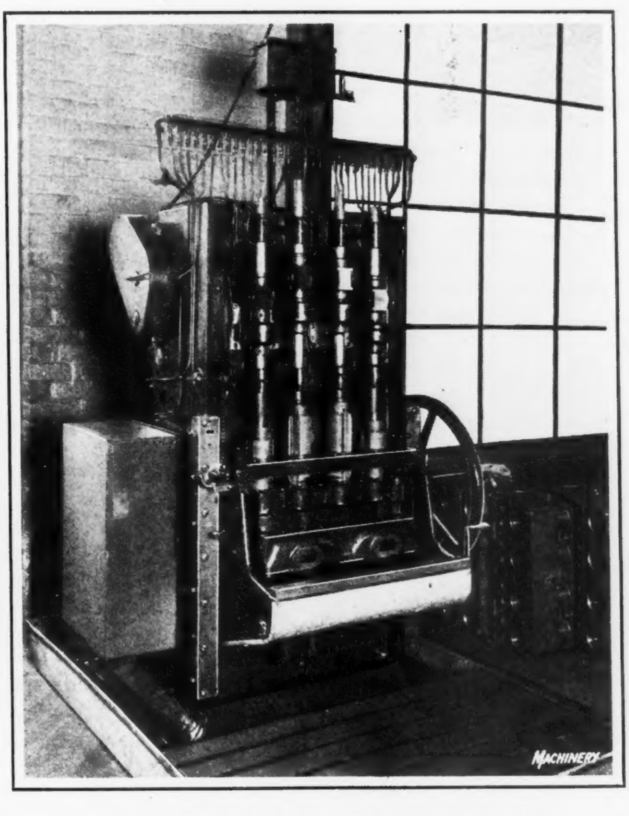
This firm maintains a special estimating department. The proposal from a machine tool builder is first passed to the estimating department, where a thorough comparison of present costs and the costs estimated with the new equipment is made. Generally speaking, in this plant, if the saving obtained with the new equipment will pay for the machine in less than one year, it is bought.

The calculation is based upon the estimated number of cars that will be built during the period in question, and the saving per car is estimated. Then the number of production days required to effect a saving that will offset the cost of the new equipment is calculated. In making this estimate, all costs are thoroughly considered, including the overhead, cost of tools, grinding of tools, cost of grinding wheels, cost of dressing the wheels, etc. There are cases on record where new equipment has paid for itself in twenty-two working days. Equipment paying for itself in from 100 to 200 working days is not unusual. In one case, equipment costing $12,000 paid for itself in less than three months. This complete estimate, together with a recommendation, is submitted to the committee on equipment previously referred to.

How Estimating Department Approaches the Subject

The questions that must be answered by the estimating department when a new machine is proposed are as follows:

1. Is this the right machine for the job?
2. Is the tooling equipment correct for the job and for the machine?
3. Will the part to be machined be improved, or will the same degree of quality, at least, be maintained, by changing its design with a view to reducing production costs?
4. What effect would a change of material in the part make?
5. What will be the cost of tools, dies, and other auxiliary equipment that goes with the machine?



Honing the Cylinder Bores at the Lincoln Plant

It will be seen that the estimating department does not assume that no change can be made in the design of the parts for the car, but that it considers both the question of design of the parts to be machined and the method and the tools for performing the work. Of course, any proposed changes in the design of the parts for the automobile must be taken up with the engineering department and receive its sanction.

When time records are available for present production, the comparison with the new method is carried out in the following manner: The operations to be done by the proposed machine are first compared with the present line-up, and the production time compared. Then an investigation is made to determine if the locating points now used will be correct for the new method, and if not, to what extent this will change the rest of the line-up. The proposal is next investigated with a view to determining whether the same results could not be obtained by the present machine if properly tooled. If not, the proposed cost is compared with the present cost and the savings, if any, are compared with the total cost of installing the proposed machine. In making this comparison, it is very important that the tool cost and the tool upkeep be considered. Often a machine will show a reduction in the production time, but either the first cost, compared with its life, or the upkeep expense, will offset the saving due to higher production capacity.

Chief Tool Designer Acts as Equipment Engineer

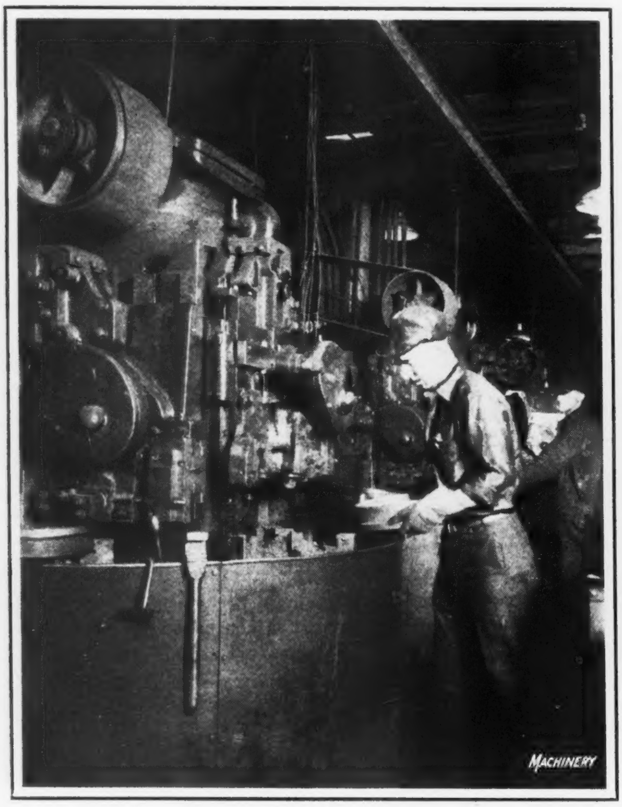
In the third plant selected as an example, the chief tool designer is also the equipment engineer. When new equipment is to be bought, he obtains proposals and production estimates from two or three concerns building what are considered to be satisfactory machines for the purpose required. The daily output and the estimate of how long the same model of car will be built without change governs the type of

machine that is purchased. The chief tool designer consults with the shop superintendent, and finally the works manager passes upon his recommendation.

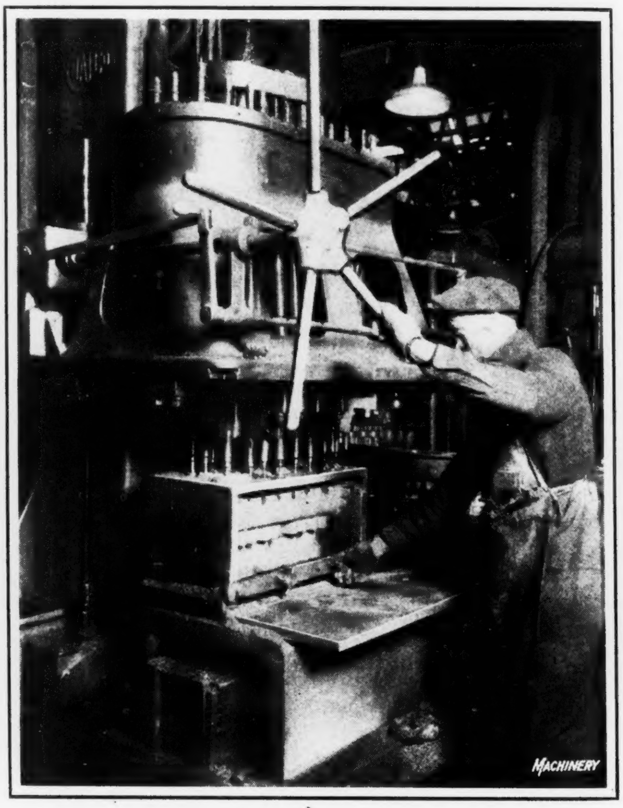
In one case, equipment was to be selected for machining flywheels. The machines of two leading machine tool builders were considered. The factors that mainly governed in the selection of the machine bought were the initial expense, the ease with which the tool set-up could be changed for different types of flywheels, and the extent to which the equipment would be tied up in case of a breakdown.

In the decision finally reached, four semi-automatic machines were selected in preference to one full automatic of the same output capacity as the four machines, because in case of a breakdown the whole producing capacity would not be tied up if four machines were used. The disadvantage with the four machines was the greater floor space required. The new equipment saved one-half of the production cost, compared with the method by which the flywheels had previously been machined. In addition, the old machines were sold and brought enough to pay one-half of the cost of the new machines. Floor space was also saved, because the new equipment took less space than the machines previously used.

In large shops, where a number of machines of one type are to be bought, one machine is frequently acquired and thoroughly tested before the complete equipment is bought. Sometimes machines from two or three different makers are tested out in this way and compared with each other. Reputable automobile concerns do all this testing at their own expense, and do not expect the machine tool builder to put in his machines on a competitive try-out.



High-production Boring and Turning on Automatic Machines at the Chevrolet Plant



Drilling Automobile Cylinder Blocks at the Plant of the Chevrolet Motor Co.

Does the New Machine Fit into the Production Line?

In deciding on new equipment—whether machines or tools—it is important to consider the regular line-up of the plant. Operations preceding and following the operation for which new equipment is contemplated must be taken into account. The locating of the work for later operations in jigs and fixtures must be considered, and the limits for subsequent operations must be determined. It has often happened that the saving due to the installation of a high-production machine in the line has been entirely lost by the increased cost on subsequent operations, and that the total production cost of the piece has been increased rather than decreased by the speeding up of some one operation.

In making his selection, the equipment engineer also considers the means for cooling the tools. The means provided for supplying cutting lubricant may spell success or failure. Often the production engineer must himself experiment with different kinds of coolants. Equipment men feel that the machine tool builder should be able to supply them with reliable information as to the best cutting lubricant to use for the operations performed on the machine, but frequently this information is not obtainable from the builder.

Selection of Turning Machines

In speaking of the selection of machines for turning—lathes, turret lathes, and automatic turning machines of various types—one equipment engineer made the following statement: "The machine tool builder does not as a rule use his own machine for production work. He, therefore, does not always know about its weaknesses until it has been put to a severe test in a high-production plant, like an automobile shop. Weaknesses in gears and worms that would never show up under the ordinary use to which machines of this type have been subjected in the past, soon give trouble in a plant where the operator strains the machine to the limit while working on a piece-work basis.

"Some time ago we selected a turning machine that appeared to be the best one of half a dozen makes. It was simple to operate, the floor space required was small, and the work produced was accurate. After the machine had been in use for a short time, however, excessive wear developed in the slides. The bearings began to be loose. They were not properly proportioned, nor properly lubricated, and the wearing surfaces on the bed were too soft for the constant moving of a heavy slide back and forth over it. In a comparatively short time, the wear on the bed amounted to 1/16 inch. We put hardened steel plates on the ways, and the manufacturer of these machines now does the same thing on all his machines, thereby materially improving the durability. These hardened steel plates can be put on the

machine when it is built at one-fourth the cost of tearing down the machine in the customer's shop and replaning the ways.

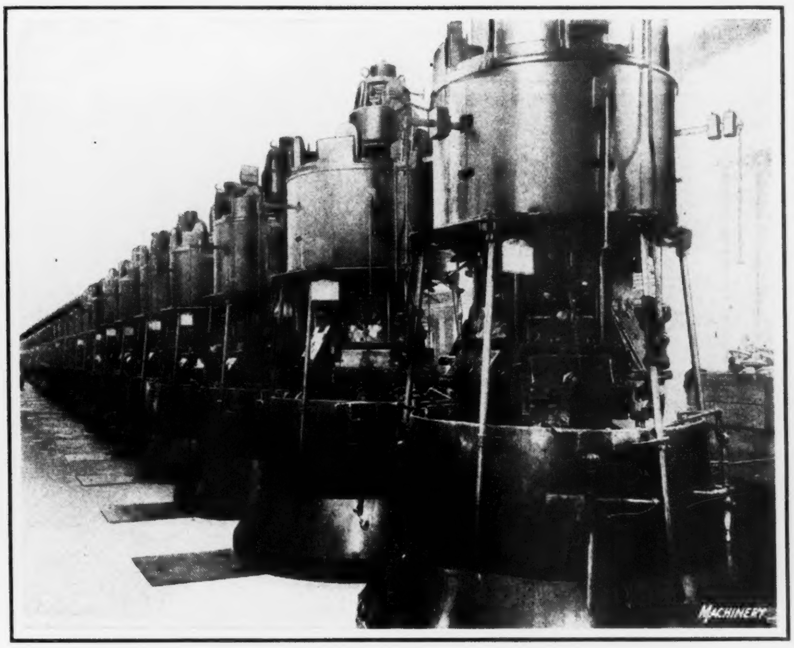
"Another feature that we have found very desirable is a ball-bearing revolving tail-center on all engine lathes, as well as on automatic machines. On machines for precision work this may not be feasible, but it is most desirable on a machine built for production work. A revolving center prevents distortion of the center of the work when heavy cuts are taken. There is no wear on the center hole of the work, nor is there any wear on the tail-center. The distortion with a stationary tail-center produces inaccuracies, and the cost of upkeep is much greater.

"Other features that I expect to find in a good turning machine are spindle bearings large enough for the heavy cuts that are now common practice; a drive close to the spindle nose; and a headstock, as well as the machine in general, heavy enough for the severe service that we expect of it. For production work we do not need gear-boxes, nor many of the other features of modern engine lathes. Production lathes can be made very simple in design and the speeds and feeds can be obtained by pick-off gears; nor do they need to be provided with means for thread cutting."

The requirements of one of the best known automobile builders, as regards milling machines, may be briefly summarized as follows: Production milling machines rather than machines of the conventional type are required. They should be of simple design, having few speeds, and feeds obtained by pick-off gears rather than by gear-boxes, although it would be well if the machines were so designed that the gear-box constituted a unit that could later be applied if required. The machines should be easy to set up. They should have unusually heavy bearings; lubrication should be provided through a tank with oil leads to every bearing; important bearings should have visible indicators or sight-feed lubrication, so that the foreman or oiler just passing the machine can see that it is properly provided with oil.

For milling aluminum, higher speeds than are generally available are required, and the machines must be designed with bearings that will be capable of running continuously at high speeds. On milling machines, as well as on all machine tools, better methods for filtering the cutting lubricant are desirable. The usual methods do not prevent the passage of very fine powder and grit, which floats suspended in the oil. Easy means for taking up any looseness of the spindle should be provided to prevent chatter. A loose spindle that causes chatter increases the cutter cost greatly. Supports, braces, over-arms, arbors, and table should be unusually heavy and rigid.

The new types of production milling machines that have been brought out within recent years meet the requirements of the automotive industry in a satisfactory manner. Still further developments in machines of these types will doubtless bring out features that will more and more make an entirely special machine unnecessary. Simplification of design, and the use of ball bearings, will reduce maintenance cost.



An Impressive Line of High-production Automatic Machines at the Ford Plant

"When I select a milling machine," said one equipment engineer, "I ask myself these questions—Is it convenient to operate? Is it rigid? Has it too many joints? Is it steady enough to be able to take heavy cuts continuously? Will its maintenance cost run high, and is it likely to require frequent repairs? Is the table low enough for the convenience of the operator?"

The development of automatic indexing fixtures for production milling machines is another step toward simplification of operation on machines of this type. In such fixtures, the production engineer looks for extreme rigidity and a fixture that indexes when the table returns. With such a fixture, one man can run more machines than without it. A fixture of this type could be designed so as to have practically standard features throughout, except that the holding device would be made as required to suit the different pieces to be milled.

Selection of Gear-cutting Machinery

In gear-hobbing machines, several engineers demand an outboard support, stating that no matter how heavy the machine is, an outboard support is of great value for heavy hobbing. The type of gear-hobbing machine depends largely upon the output. The single-purpose machine is advantageous from many points of view, provided the output is large enough to warrant its installation. It can be designed with fewer joints and generally simplified in design; but unless the production is large enough to warrant such a machine, it is likely to stand idle for long periods, in which case a more universal machine, that can be used on a varied line of gear-cutting might prove to be a more satisfactory investment.

An engineer responsible for the equipment in one of the best known automobile plants in the country emphasizes the following points: "All bearings should have forced-feed lubrication. In one case, the choice between two heavy-duty gear-hobbing machines was determined by the excellence of the lubrication of one of the machines. The machine bought was more expensive, but was acquired because it had a better lubricating system and hence could be expected to last longer without repairs. The necessity of tearing down the machine once, would eat up all the saving from buying the cheaper machine. Maintenance cost is a very important item, and high production is of no more value to the automobile manufacturer than a machine that is easy to maintain in good running condition, and on which repairs can be easily and cheaply made right on the job. In striving for high production capacity, the feature of durability has sometimes been sacrificed."

Drilling Machine Requirements

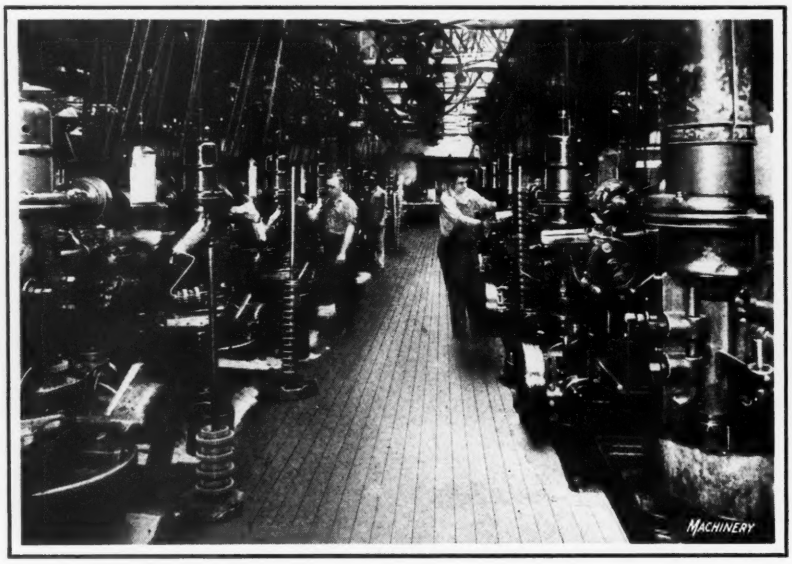
The important things that the equipment engineer looks for in drilling machines are ball bearings, automatic lubrication, gears of sufficient size and of properly heat-treated material, as large a spindle as possible, and all other shafts large in diameter and short. Thrust bearings of ample size and properly designed are also of great importance. In one

plant, it was stated that the greatest difficulties in the maintenance of drilling machines were due to thrust bearing troubles and troubles with the worm-gear feed.

Jointed arm radial drills find application for certain work in an automobile shop, and they are convenient to use, but should be designed with a very light arm, moving in ball bearings. It has been suggested that the moving parts be made of aluminum. Such machines should also be provided with a tapping attachment for tapping up to 1/2-inch holes. Machines of this type are now on the market, but still further developments are being looked for by automobile engineers.

What the Equipment Engineer Looks for in Grinding Machines

A large number of equipment engineers find the selection of grinding machines one of their most difficult problems. They state that all the leading grinding machine manufacturers have provided their machines with some very good features, but as no machine includes all these features, it becomes difficult to make a choice. The following features are mentioned by a large number of buyers in the automotive industry as the most important in grinding machines: Large heavy bearings, and spindles and bearings so designed that they will not be too sensitive to temperature changes. Sometimes high-speed spindles run free when cold, but bind when they become heated. Some engineers consider improvements possible in grinding wheel bearings and spindles, and believe that the machine tool builder will find means of accomplishing still better results than in the past. Under no circumstances should water or grit flow over the bearings so that there would be any danger of its entering the bearing surfaces. Other important considerations are the methods of lubrication; the size of, and metal in, the ways, insuring long life; and a simple design that will not readily get out of order. Automatic sizing attachments are highly desirable, and are considered by many one of the most important features in certain types of grinding machines.



Gear-cutting Department in the White Motor Co.'s Plant

Gear Grinding Machines in Automobile Plants

The development of the gear grinding machine has created many new problems for equipment engineers; methods and processes that were at one time considered practically settled have been upset, and changes are constantly being made. In buying a gear grinder, its production per hour, the accuracy of the product, the durability of the design, and the theoretical correctness of the grinding method are all analyzed, and different machines are compared with each other on the basis of these considerations.

Where there is high production, a machine designed to grind a single size of gear would be preferred, but where a number of gears must be ground on the same machine, it is important that the machine be capable of being easily changed over from one kind of gear to another. One automobile firm states that savings equal to $70 a day have been made on salvaging gears alone, by means of gear grinding.

In one plant some interesting figures have been arrived at by making careful records of costs, showing that in the production of high-class gears it is actually possible to reduce costs by gear grinding. According to the figures obtained in this plant, the costs of producing the best gear possible, previous to the introduction of the grinding method, for five different gears, were as follows:

$1.70 $1.02 $0.36 $0.99 $0.76

The introduction of the gear grinding process made it possible to produce these gears at the following costs, respectively:

$1.65 $0.84 $0.34 $0.79 $0.66

One advantage that has been obtained in this plant in addition to the reduction in the cost of the gears, is that the ground gears do not have to be matched in sets. Formerly transmission gears quite frequently had to be changed on assembled cars, the gears having to be rematched for quiet running. The pulling down of the assembled gear set and matching with another gear cost about $2 per car, which is now saved.

By the present method, the teeth are hobbed and then finished by grinding after hardening. The cost of the grinding wheels practically balances the cost of the finishing cutters used when the teeth are not ground, so that the tool cost may be considered about the same. The inspection of the grinding wheels required at intervals is cheaper than the inspection required for maintaining the cutters formerly used for finishing the gears.

Centerless Grinding

In one plant, whenever a grinding job arises, the question is always asked, "Could this possibly be done on a centerless grinding machine?" The savings that have resulted in the past from the use of machines of this type have made production managers very partial to this type of machine. Frequently its use has made it possible for one man to produce what formerly required three or four men. Still, the process has not yet reached its final development, but will doubtless be further improved in the future. Attachments are now designed to meet conditions for which the machine at first did not seem suitable, as, for example, for different classes of shoulder work.

Cost of Dressing Wheels

An important item in connection with grinding machines is the cost of dressing the wheels. One equipment engineer estimates that it costs 15 cents to dress a wheel by a diamond, and any method whereby wheel-dressing costs can be reduced would save a great deal of expense. A new method of dressing by means of another wheel is now being introduced in many plants, and is said to have proved very successful and to have cut wheel-dressing costs practically in half.

When it is remembered that the automobile industry uses over $1,200,000 worth of diamonds annually for dressing wheels alone, it will be appreciated that an improvement in wheel-dressing methods is of the greatest importance. In one of the low-priced cars, the diamond cost per car is 27 cents; for one of the high-priced cars it is about 60 cents. In addition to their use for dressing grinding wheels, diamonds are also employed in a number of automobile plants for turning purposes, especially for the turning of bronze bushings.

Cost of Grinding Wheels in the Automobile Industry

It has been estimated that grinding wheels to a value of $8,000,000 are being consumed annually in the building of automobiles. Even the smallest car made uses up a dollar's worth of grinding wheels per car, and some of the large, expensive cars use as much as $4 worth of grinding wheels per car. It has been suggested that possibly the wheel cost could be reduced by using larger holes in large wheels. If, for example, 20-inch wheels are used, they might be provided with a 12-inch hole, so that less abrasive would be used in the wheel and the wheel could be used up almost entirely. Whether this is practicable or not, will have to be decided by grinding machine manufacturers and wheel makers in cooperation.

Cylinder Honing or Lapping Machines

There are now several cylinder honing and lapping machines on the market, and each one has found advocates among equipment engineers. There are also many home-made outfits in use. But there is still no generally accepted method for honing cylinders, some engineers claiming advantages for one method, while others prefer another. One tool engineer says: "I prefer hones that have no springs and that can be expanded in a positive manner like an expansion reamer. Such a hone may be expanded gradually as the honing process proceeds, the operator giving the adjusting nut a slight turn. Such a hone will always produce a round hole, though the surface may not always appear to be as highly finished as one that is produced by a hone having springs. The latter type of hone produces a finer looking hole, but it is not always perfectly round."

Another hone is provided with an extremely heavy flat spring supporting the hones, so that the hone is, in effect, solid, and it is expanded by a positive adjustment.

As to the actual motion required to produce the best surface, there are also differences of opinion. One engineer, well versed in the subject, advocates a quite rapid rotary movement accompanied by a gradual up and down movement; another, a rapid up and down motion and a comparatively slow revolving motion. New developments are taking place in this field right along and doubtless the process will gradually be developed to a point where the best method will be definitely agreed upon.

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THE PRODUCTIVE POWER OF MACHINES

In a paper read by W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, before the Machine Shop Division of the American Society of Mechanical Engineers at its meeting recently held in Cleveland in conjunction with the annual meeting of the American Steel Treaters' Association, it was pointed out that the output of one man in the textile industry today, operating automatic looms, is equal to the output of 192 weavers using hand- and foot-power looms in 1804. In the spinning industry the comparison between hand labor and modern machine methods is even more startling. One spinner in a modern textile mill, it is stated, with the machinery and power there available, is able to turn out a volume of work equivalent to the product of 45,000 people operating the old-fashioned spinning wheels of a century ago.

This method of comparing the power of machinery as compared with hand labor may be extended in other directions, for example, in connection with transportation. There are places in China today where goods are handled in much the same way as they were two thousand years ago, and a coolie will load a wheelbarrow and start on a trip that, from our point of view, is almost unbelievable. In one such journey that had come within Mr. Rastall's personal experience, a coolie loaded a wheelbarrow with 300 pounds of merchandise and pushed it 800 miles, at the end of which he brought back a similar load. It is of interest to note that this Chinese coolie receives about five cents for every 10 miles covered. Probably ten, or at most fifteen, cents a day constitutes his total pay. Consider the millions of wheelbarrows it would take to move the freight now handled by American railroads.

Mr. Rastall further mentions that it has been estimated that the power and machinery used in American industry is equivalent to more than 3,000,000,000 workers employing muscular power and skill. As our industries do not employ a one-hundredth part of that number, it is easy for us to understand why our standard of living today is so much higher than it was centuries ago. Frequently men have been known to be unwilling to use improved machinery because they thought it would deprive them and their fellow workers of their work, but in spite of the liberal use of machinery, there is apparently less fear of unemployment today than there was some centuries ago, when each worker considered his one task as his only means of livelihood.

On the other hand, the use of machinery has so multiplied man's power of production as to permit a multiplication of his chance to consume. The standard of living of different nations depends largely upon the extent to which they employ modern industrial equipment anad means of transportation. In other words, when machinery is exported to a foreign country, we are in reality aiding in improving the standard of living in that country.

* * *

MACHINE TOOLS FOR AUTOMOBILE SHOPS

In discussing the paper on "Machine Tool Needs of the Automotive Industry," read by R. M. Hidey of the White Motor Co., before the Production Meeting of the Society of Automotive Engineers in Cleveland, A. C. Cook of the Warner & Swasey Co. pointed out that the fact that the automotive manufacturing plants today are largely equipped with standard machine tools, fitted with special tools and fixtures, indicates that the automotive industry has found the use of standard machines more profitable than the use of special machines. The standard machine tool, being produced in larger quantities, can, of course, be sold at a lower price. Furthermore, it is a machine with which the ordinary workman is more or less familiar from the beginning. The building of standard machines is also more advantageous to the machine tool builder, because the building of special machines and fixtures is, as a rule, not very profitable.

Mr. Cook also pointed out that the majority of machine tool manufacturers experiment long and carefully with a new product before it is placed on the market. In one case a machine of a new design was tested and experimented with by its manufacturer for nearly two years before being marketed.

In regard to standardization, Mr. Cook pointed out that there are several sides to this question, one of which he called attention to as follows:

"Supposing you have in your shop fifty engine lathes of the same size and make, and with the same spindle thread. Now supposing further that the machine tool industry decided to adopt as standard for 16-inch engine lathes a different thread from those you have on your machines, you can well imagine the confusion that would result. If the spindle threads of all 16-inch lathes were to be made identical, it is probable that no existing spindle thread would be used, and the only way to solve the problem would be to compromise on a non-existent thread. In certain lines of machine tools, it is possible to have special spindle threads made to order. Thus, for instance, if the fifty engine lathes now in your shop are equipped with the thread of manufacturer "A," and you wish to purchase some 16-inch machines made by manufacturer "B," I am sure the latter would be glad to equip his machine with the thread you are now using, which would solve your problem. This would probably cause less confusion than for all manufacturers to change over and use the same thread."

DRILLING SCREEN HOLES IN OIL-WELL CASING

By CARROLL S. ASHLEY

Certain oil-wells in Southern California are drilled in a sandy formation, and no matter how great or how low the production, the wells have a tendency to "sand up"; that is, the fine sand flowing into the casing with the oil fills the lower part of the casing. This happens, regardless of whether the oil is being pumped out or forced out by the gas pressure behind it. The shutting down and "swabbing out" of the pipes when they sand up delays production and is a laborious and costly task.

The usual method of putting in a casing that has been slotted, perforated, or drilled has disadvantages and does not always prove satisfactory. In performing the drilling or slotting operations, burrs are left on the inside of the casing, and the oil and sand together form an abrasive that accentuates the burrs and makes the swabbing operation very difficult and unsatisfactory.

This trouble has recently been overcome by drilling the screen pipe or casing from the inside. In Fig. 1 is shown a section of screen casing with the holes countersunk from the inside. The difficulties encountered in designing a machine for drilling so many holes accurately and rapidly can be fully realized when we remember that the oil-well casing is often only 3 inches in diameter. The first machine built for this drilling operation was designed to carry the pipe or casing on a mandrel. The mandrel was made of sufficient length to handle a piece of pipe 22 feet long. The drill chucks mounted in the mandrel were driven by miter gears from a small shaft located within the mandrel. The drilling operation was performed by pressing the pipe down against the upright drills.

After the holes were drilled through the casing, a prick-punch was driven into each hole in order to give it a slightly countersunk form. At the present time the holes are drilled from the outside by a multiple-spindle machine and countersunk from the inside in a second operation to within about 1/16 inch of the outer surface. By countersinking the holes from the inside, the burrs are eliminated and the countersunk openings have a tendency to retain their shape, regardless of the abrasive action of the sand and oil. The coarser sand and pebbles not being able to enter the strainer holes, form a kind of filter on the outside of the pipe, which gives very satisfactory service. The even distribution of the holes in the screen casing and the small amount of metal removed in drilling them leaves the pipe practically as strong as before the drilling operation. This is an important factor, as otherwise the pressure to which the casing is often subjected would cause the pipe to collapse.

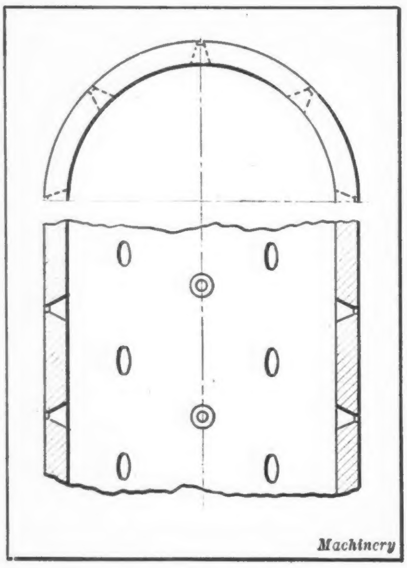

Fig. 1. Section of Oil-well Screen Pipe

At the present time the drilling equipment used in producing the screen holes in an oil-well casing consists of two multiple-spindle drilling machines having 163 and 114 spindles, respectively. All the spindles are fitted with ball bearings and are belted to one shaft driven by a motor. The largest drilling machine has a capacity for drilling sections of pipe 34 feet long. The pipe is fed upward against the drills by three jack-screws connected by worm-gearing to a drive shaft, which is power-driven and reversible. The indexing is done by hand, and two operators are required, one to operate the indexing and feeding mechanism, and the other to watch the drills.

The output of the machines described for each eight-hour shift is 300 feet of 6-inch pipe, having ten rows of holes spaced 2.5 inches apart. In Fig. 2 is shown one of the multiple-spindle drilling machines before the feeding mechanism had been completed. It may be of interest to note here that George Watson, who developed the methods and machines described, has had twenty-five years experience in the oil-well business, and that he has recently developed a new method of drilling screen pipe referred to as "rotary screen." This newly developed screen pipe has the holes drilled at an angle, which gives the inrushing oil a whirling motion that tends to keep the surface of the screen washed clean. The whirling motion also assists materially in carrying the sand up and out of the pipe with the gas and oil.

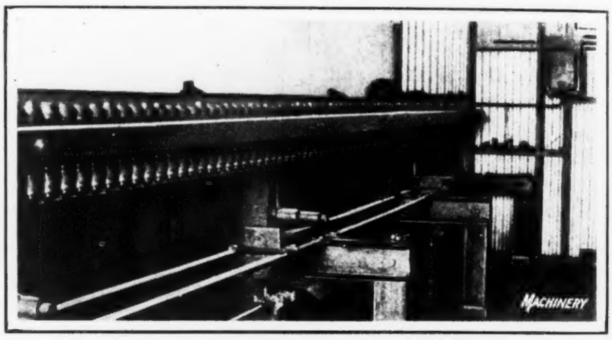

Fig. 2. Machine for drilling Oil-well Screen Pipe

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THE CZECHO-SLOVAKIAN MACHINE INDUSTRY

A correspondent from Czecho-Slovakia writes us that the machine industry in that country is fully occupied. It is the one industrial field in which there is, at present, no unemployment—a very gratifying condition in view of the fact that there were 60,000 unemployed in this industry in 1922 and 20,000 in 1924. The reason for this activity is largely that prices on German machinery have risen, so that the Czecho-Slovakian factories are able to compete with the German industry in foreign markets. Also, some new commercial treaties especially one with Poland, have aided in increasing the employment of the machine industries in Czecho-Slovakia.

The automobile industry is very active. None of the automobile plants in the country carries any stock, and buyers have to wait from two to three months for deliveries. Factories producing electrical equipment are also active. Both of these groups are working for the home market. Another important branch of the machine industry is devoted to agricultural machinery. This branch is also well employed, but largely for foreign markets, more than half of the product of some of the plants being exported. Their future, therefore, depends upon the conditions abroad, and especially upon prices of German products. At present these are rising, which favors the Czecho-Slovakian industry.

Of American machine tools, milling machines, grinding machines, and multiple-spindle automatics are mainly in demand. Special automatic machines may also find buyers if they are not intended for production in too large lots. Milling cutters of quality can also be sold. The opportunities for selling lathes, boring mills, drilling machines, shapers, planers, slotters, turret lathes, and single-spindle automatics—except for some special designs of the last two lines—are not very good. Machines for very large quantity production are also unsuitable for this market, as only in exceptional instances can they be fully employed in the Czecho-Slovakian factories, the largest automobile factory for example, having an output of only 5000 cars per year.

National Machine Tool Builders' Meeting

A LARGE attendance and active interest in the proceedings characterized the twenty-fourth annual convention of the National Machine Tool Builders' Association held in Washington, D. C., September 30 to October 2. In his address to the association, the president, O. B. Iles, president of the International Machine Tool Co., Indianapolis, Ind., called attention to the improved business conditions in the machine tool industry. "After five years of very unsatisfactory business," said Mr. Iles, "the outlook seems to be brighter, basic conditions generally are good, the after effects of the World War seem to be righting themselves, and many of the bad conditions generally are gradually disappearing."

President Asks for Higher Business Standards

Mr. Iles pointed out that the keen competition for business during the last few years has developed or accentuated many business practices that should not exist, and emphasized the need for taking definite action to eliminate or correct these objectionable conditions for the good of the industry as a whole. In a very strong appeal, he pointed out that it should be the duty and aim of every manufacturer to do everything possible to raise the level of existing business standards. During the last few years there has not been business enough to take care of all the capacity of all the shops in the machine tool field. There have been too many machine tool builders to supply the very limited demand, a condition that has created anxiety and that at times has led to objectionable practices and business methods.

The aid the Government is offering business at the present time, especially in the foreign fields, was another subject dealt with by Mr. Iles. He pointed out that these services of the Government are being utilized by many industries with much benefit, and that machine tool builders could also use this agency to a greater extent than has been the case in the past.

H. M. Lucas, Newly Elected President of the National Machine Tool Builders' Association

General State of the Machine Tool Industry

In his report to the association, Ernest F. Du Brul, its general manager, stated that the volume of new orders in the machine tool industry is now very close to the level reached in the spring of 1923. General business conditions indicate a still further improvement, but machine tool builders should give close study to the business factors that affect the rate of demand for machine tools. Much of the present activity of the country is due to continued building construction. This activity cannot continue indefinitely, and when it falls off, the general demand for consumer goods may be materially affected, which, in turn, would reduce the demand for machine tools.

"The automobile industry, the main source of demand at the present for machine tools," said Mr. Du Brul, "will also bear watching. There are many automobile companies whose equipment is far from up-to-date, and they should therefore furnish a very good market for replacement of obsolete and worn out machinery; but even necessary replacements are not freely purchased when the demand for the product of the machines shows signs of slackening. When business slumps, the less efficient machines are simply not used, the production load is taken by the efficient machines already installed, and the owner waits for the next wave of demand before replacing old machines. A recession in general prosperity, such as might come from a recession in building, seems likely to reduce the demand for automobiles. Therefore, it is wise to be ready for a recession in machine tool demand from the automobile industry and not to count too strongly on its continuance."

Another factor emphasized was the credit situation. The Federal Reserve Banks are now being called on for loans in increasing amounts. This is a legitimate function of the reserve banks, but it is well to watch whether this extension of credit is proceeding so rapidly as to indicate injudicious booming of business. "No industry needs careful, sane, conservative management," said Mr. Du Brul, "as much as the machine tool industry. Just when the rest of the country is most optimistic is the time when the machine tool builder needs to be most careful."

Statistics and Standardization Needed in the Machine Tool Industry

In calling attention to the needs of the machine tool industry, it was stated that in order that the industry may have ample warning of coming events, much better statistics than have been available in the past are needed. These statistics should cover completely the orders, cancellations, and shipments of the industry each month. It is also evident that many of the important customers of the machine tool industry need enlightenment on the industry's problems, and that greater participation on the part of the leaders in the machine tool industry in the meetings and proceedings of large organizations of machine tool users would be of considerable value. For example, the Production Meeting of the Society of Automotive Engineers deals very largely with machine tool equipment and problems connected with production. This meeting has as much of interest to the machine tool builder as to the automotive production engineer.

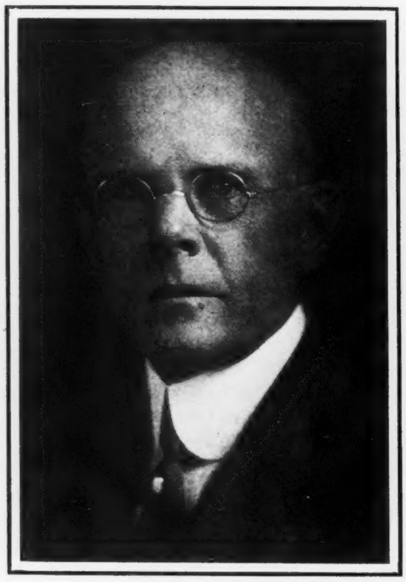
The need for standardization of tool-holding and work-holding elements of machine tools was mentioned. At the recent Production Meeting of the Society of Automotive Engineers in Cleveland, several speakers stated that the automotive industry needs standardization of such features as spindle noses, turret holes, lead-screws, working heights, and similar items. Mr. Du Brul called attention to the work done in Germany, where nearly one thousand standards have been adopted in the last few years, 60 per cent of which deal with the machine industry. Austria, Belgium, Czecho-Slovakia, Holland, Hungary, Norway, Sweden, and Switzerland have joined with Germany in this work.

One thing that could be done quickly is to standardize the nomenclature used for machine tools and machine tool parts. This does not involve any change of shop standards, but it would make the language of the machine tool industry universally understood and would improve competitive conditions.

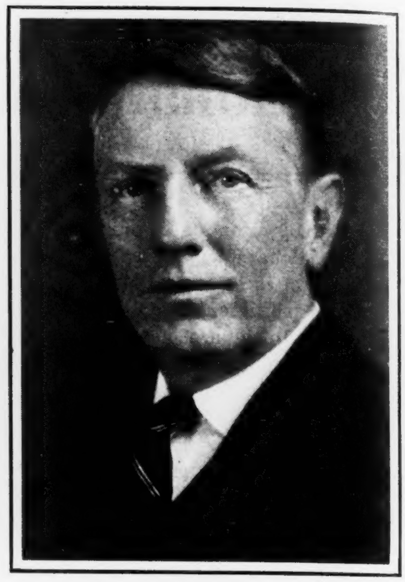
Elimination of Unnecessary Sizes would Save Waste

It was pointed out that there is a multiplicity of sizes in many types of machines. A great saving could be made by

J. G. Benedict, First Vice-president of the National Machine Tool Builders' Association



H. L. Flather, Second Vice-president of the National Machine Tool Builders' Association



Edward A. Muller, Treasurer of the National Machine Tool Builders' Association

eliminating unnecessary sizes, the same as other industries have done. Individual concerns have done a great deal to eliminate unnecessary sizes in parts entering into the finished machines. In one case, shaft collars were standardized. A very large number of shaft collars had been in use, because whenever one was needed, the draftsman would make a drawing to suit his own fancy; hence, there was an unlimited variation of thicknesses, diameters, and sizes of holes. By standardization within the plant, this large collection of shaft collars was reduced to a very few sizes. Many other machine elements were standardized, at considerable cost, but with a view to ultimate savings.

In the same city, however, another machine tool builder went through exactly the same process, expending a great deal of time and money. All over the country similar work is carried on in individual shops, all of them duplicating the expense. Ultimately, each one will have a different standard from the others. Here is a case in which, by one expenditure incurred cooperatively through the Machine Tool Builders' Association, the whole industry could have been benefited and considerable expense saved each concern now doing this work for itself. Furthermore, standards would have been adopted that the whole industry could use.

The machine tool industry is spending hundreds of thousands of dollars each year on experiments and research work; but this money is spent individually, and while in many cases this individual expenditure cannot be avoided, there are many other instances where the results could be procured at much less expense by cooperation in research on problems common to a number of manufacturers. As taxpayers, manufacturers support numerous research institutions, and these institutions could well be made use of. Mr. Du Brul concluded his report by reviewing the state of the membership, mentioning that at the present time the association numbers 109 members.

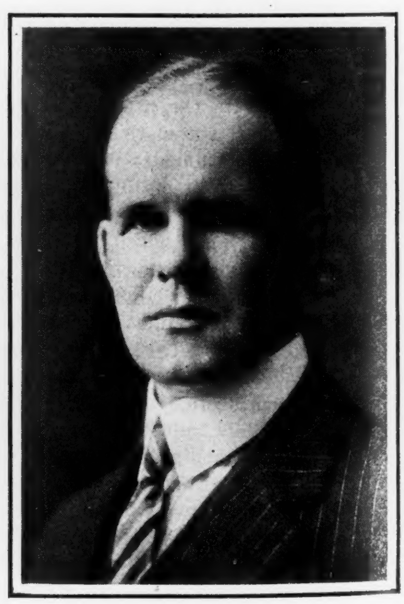
What the Government Does to Help Business

One of the sessions of the convention was held at the Department of Commerce Building, where Secretary Hoover addressed the association, mainly on the subject of trade association activities and the aid that the Department of Commerce can render industry in domestic and foreign fields. Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, gave a comprehensive review of the work of the department and its importance to industry, which was followed by brief talks by a number of the division executives of the department, each outlining the service that his department is in a position to render.

At the Bureau of Standards, the association was addressed by Dr. George K. Burgess, director of the bureau, who briefly

P. E. Bliss, Newly Elected Director of the National Machine Tool Builders' Association

Ernest F. Du Brul, General Manager of the National Machine Tool Builders' Association



Henry K. Spencer, Newly Elected Director of the National Machine Tool Builders' Association

outlined the extensive work carried on in its laboratories. An inspection trip was then arranged through some of the most interesting departments of the bureau.

In an address on "Machine Tools and the Munitions Program," Major R. H. Somers of the Ordnance Department, outlined the preparatory work that is being done by the Army Staff in coordinating the service of industry to the Government in time of national emergencies. The last day of the convention was devoted to a joint meeting with the Army Ordnance Association at the Aberdeen Proving Grounds, where army ordnance material was exhibited.

Code of Ethics in the Machine Tool Industry

The code of ethics for the machine tool industry submitted by the committee on code of ethics at the meeting of the association last spring was adopted. This code was published in June MACHINERY, page 822. Important reports were also presented by the advertising committee, the committee on obsolete parts, the plant capacity committee, and the committee on training of salesmen. A paper on direct mail advertising by George Erwin, of the Kearney & Trecker Corporation, Milwaukee, Wis., attracted considerable attention.

Repair Parts for Obsolete Machines

The committee on repair parts for obsolete machines submitted the following principles based on average practice:

1. The machine tool builder should be able to supply repair parts promptly for a period of five years after manufacture of the machine ceases. An exception may be made to this in the case of machine frames and other heavy parts not usually called for as repairs. These bulky patterns may be safely discarded within two or three years.
2. The builder should be able to supply usual repair parts for five years longer, that is, up to ten years after manufacture ceases, but during the second five years he is not fairly under obligation to supply parts promptly.
3. The builder should be under no obligation to supply any repair parts more than ten years after the manufacture of a machine ceases. It should be optional with each builder whether he shall continue to supply parts for longer periods.
4. Prices of repair parts should at all times be based on actual cost plus a reasonable margin of profit.

Election of Officers for the Coming Year

The officers for the coming year are: H. M. Lucas of the Lucas Machine Tool Co., Cleveland, Ohio, president; J. G. Benedict of the Landis Machine Co., Waynesboro, Pa., first vice-president; H. L. Flather of the Flather Co., Nashua, N. H., second vice-president; and Edward A. Muller of the King Machine Tool Co., Cincinnati, Ohio, treasurer. Three new directors to serve for three years were elected: P. E. Bliss of the Warner & Swasey Co., Cleveland, Ohio; Edward A. Muller of the King Machine Tool Co., Cincinnati, Ohio; and Henry K. Spencer of the Blanchard Machine Co., Cambridge, Mass.

* * *

AMERICAN FOUNDRYMEN'S MEETING

The attendance at the American Foundrymen's Association convention held in Syracuse, N. Y., October 5 to 9, was unusually large. The total registration reached 3350. The technical program was very extensive, and over sixty papers were presented on subjects covering every phase of foundry practice. One of the features of the convention was the presentation of British and French exchange papers. A large exhibition was held in conjunction with the meeting, there being about 200 exhibitors. A floor space of 57,000 square feet was covered by the exhibits.

* * *

An official statement issued by the American Electric Railway Association commends automobile buses as an auxiliary to electric railroads and not as a competitor, and states that 249 traction companies are now operating about 4500 buses over nearly 12,000 miles of routes.

RAILROAD SUBJECTS DISCUSSED BY A. S. M. E.

At the regional meeting of the American Society of Mechanical Engineers held at Altoona, Pa., October 5 to 7, a number of important papers relating to the railroad field were presented. One of the outstanding events of the meeting was the conferring of honorary membership upon General William Wallace Atterbury, president of the Pennsylvania Railroad System, who rendered distinguished service in connection with railroad transportation in France during the World War. He directed the construction and operation of the United States military railways, and served as Commanding General and Director General of Transportation of the American Expeditionary Forces. He was decorated for his services by France, Great Britain, and Belgium, and also holds the Distinguished Service Medal of the United States. General Atterbury graduated from Yale University in 1886, and has been in the service of the Pennsylvania Railway ever since, entering immediately upon his graduation from Yale University as an apprentice in the Altoona Shops of the Pennsylvania Railroad. He has been a member of the American Society of Mechanical Engineers for thirty-one years—since 1894.

Numerous addresses were made and several valuable papers read at the meeting. Samuel Rea, past president of the Pennsylvania Railroad, made a comprehensive address on "American Transportation," covering the subject from almost every angle. With an unusually fair and impartial mind, Mr. Rea analyzed present railroad problems. Samuel P. Bush, president of the Buckeye Steel Castings Co., made an address on "The Transportation Industry and the Engineer"; A. J. County, vice-president of the Pennsylvania Railroad, spoke on "The Growth of a Great Transportation System"; and Robert S. Binkerd, vice-chairman of the Committee on Public Relations of Eastern Railroads, spoke on "The Railway as an Economic Force."

A comprehensive paper on "The Locomotive Testing Plant and its Influence on Steam Locomotive Design" was read by Lawford H. Fry, metallurgical engineer of the Standard Steel Works Co., Burnham, Pa., and a paper on "Rustproofing of Materials" was read by Dr. M. E. McDonnell, chief chemist of the Pennsylvania Railroad System. An abstract of the latter paper will be presented in a coming number of MACHINERY. Copies of other addresses made and papers read may be obtained by addressing the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

It is of interest to note that the third meeting of the American Society of Mechanical Engineers was held in Altoona in 1883. The vast forward strides of engineering and transportation since the society met there forty-two years ago were referred to by several of the speakers.

An inspection trip of the Altoona works and locomotive testing plant had been arranged for. These works are the largest railroad works in the world, employing about 13,000 people; they represent an investment in plant and machinery of over $27,000,000, and have an annual payroll of about $18,000,000.

The Altoona works are devoted both to the building of new engines and to the repairing of old ones. About three-quarters of the total number of locomotives required for replacements are built here, and one-half of the locomotives repaired on the Pennsylvania System are taken care of in the Altoona Shops. In addition, one-half of the passenger cars needing repairs are handled here for the entire system, and all parts for locomotive, passenger car, and freight car repairs used at all other shops and assembly plants throughout the system are made here.

The volume of work handled by these shops may be understood from the fact that the equipment of the Pennsylvania Railroad consists of 7300 locomotives, 270,000 freight cars, and 6800 passenger cars. Over 300 new engines are placed in operation on this system annually. At the present time a new electric engine has been developed and built by the Pennsylvania Railroad in the Altoona shops.

Standardization by Gear Manufacturers

THE fall meeting of the American Gear Manufacturers' Association, held at West Baden, Ind., October 1 to 3, was characterized by the same careful attention to standardization work and the technical details of gear-manufacturing as in the past.

At the first session, E. J. Frost of the Frost Gear & Forge Co., Jackson, Mich., president of the association, reviewed briefly the work done by the association, calling attention to its rapid growth to an organization that now embraces in its membership not only practically every manufacturer of cut gears in the United States, but several members abroad. He asked the members to recognize, however, that there is much yet to be accomplished.

"While it must be admitted," he said, "that collectively there has been an enormous amount of effort and time spent on the work of the various standardization committees, we must not content ourselves with past accomplishments, but patiently and steadfastly keep up the work until that which we have set out to do has been done. At best, the progress of standardization work is slow, as many minds must meet and agree, and when it is considered that we labor not by and for ourselves, but in conjunction with other engineering bodies, with the expectation that what we do will not only become the standards of the American Gear Manufacturers' Association, but United States standards which, if possible, shall be accepted throughout the world, our labors and the very slowness with which we move find justification."

Mr. Frost also called attention to the need for commercial standardization, mentioning that the progress in this direction has not been so marked as in the direction of technical standardization. The need for uniform cost systems in gear plants was emphasized, and the members were asked to give constructive thought to the commercial as well as the technical side of the gear manufacturing business.

Cooperation with the United States Government

Proceeding, Mr. Frost mentioned that he had been in correspondence with various government officials with the view of tendering the services of the association in the preparation of specifications relating to material for and design of gearing. When gear manufacturers receive drawings on which they are expected to quote, the product should be capable of being made with standard equipment and tooling and to limits commercially obtainable. Mr. Frost quoted an instance showing the need for such cooperation. Drawings were submitted to a gear manufacturer for bevel gears that required no great refinement when in use. Nevertheless, the angular dimensions were given to a degree of accuracy three hundred times greater than obtainable by the setting

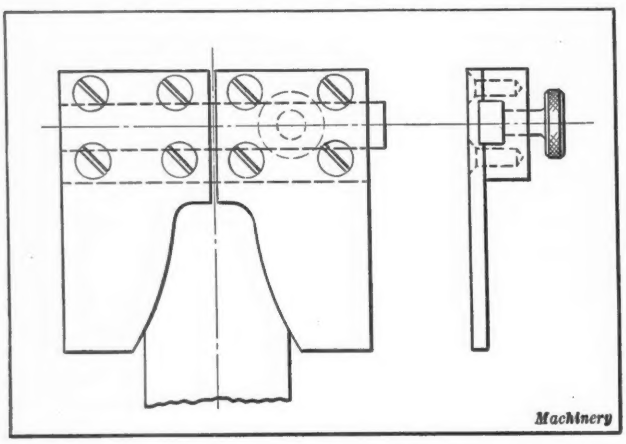


Fig. 1. Adjustable Templet for testing Tooth Form

TABLE 1. VALUES OF S FOR VARYING PITCH LINE VELOCITIES IN FEET PER MINUTE

Pitch Line Velocity	S	Pitch Line Velocity	S	Pitch Line Velocity	S
100	5143	700	2769	1700	1565
150	4800	800	2571	1800	1500
200	4500	900	2400	1900	1440
250	4235	1000	2250	2000	1385
300	4000	1100	2118	2200	1286
350	3789	1200	2000	2300	1241
400	3600	1300	1895	2400	1200
450	3429	1400	1800	2600	1125
500	3273	1500	1714	2800	1059
600	3000	1600	1636	3000	1000

Machinery

of a Gleason generator. Even if these gears could have been produced as accurately as called for in the blueprint, it is doubtful if this accuracy could ever have been checked by inspection, unless possibly some plant engaged in making astronomical instruments had been called upon to check the work.

"Millions of dollars are squandered annually," said Mr. Frost, "on manufacturing commodities to specifications that could be vastly improved both in regard to materials and design, and the association should take the lead in remedying this uneconomical condition."

Attention was also called to the need of cooperation with engineering schools and colleges, where a great deal of experimental work could be carried out to a practical conclusion, if the members of the association were in direct contact with those carrying out these experiments.

Progress of General Standardization Work

B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., chairman of the general standardization committee, reported on the general progress of the standardization work. Progress reports were made by the spur gear and the bevel gear committees. The worm-gear committee has done a great deal of work and presented tables and formulas for the calculation of the horsepower of worm-gearing. Progress reports were presented by the sprocket committee and the differential and transmission committee. The tooth form committee, the metallurgical committee and the inspection committee presented recommended practices for a conjugate rack, steel castings for gears, and the inspection of gear-cutters, respectively. The library committee, the herringbone committee, the committee on gears and pinions for electric railways, mills, and mines, and the keyway committee presented progress reports. The non-metallic gear committee presented a method for computing the horsepower of non-metallic gears, together with data sheets representing a great deal of detail work. The nomenclature committee presented a progress report outlining recommended symbols for gear calculations.

Papers Read before the Convention

A number of papers of unusual interest were read before the meeting, as follows: "The Machine Hour Rate—An Ideal Foundation for Gear Prices," by E. A. Kebler, president, Fawcus Machine Co., Pittsburg, Pa.; "Improvements Needed in Automotive Steels," by W. G. Hildorf, consulting metallurgist, Reo Motor Car Co., Lansing, Mich.; "Military and Commercial Aeronautics and the Problem Confronting their Development," by Brig. Gen. J. E. Fechet, Assistant Chief of Air Service; "Recent Developments in Gear Research," by C. W. Ham, associate professor of machine design, University of Illinois, Urbana, Ill., and J. W. Huckert, assistant

professor of mathématics, University of Louisville, Louisville, Ky. (This paper is available in a bulletin published by the University of Illinois and may be obtained by addressing Professor Ham; the conclusions drawn from the tests will be found on page 197 of this number of MACHINERY.); "Measuring Gear Teeth," by J. L. Williamson of the Fellows Gear Shaper Co., Springfield, Vt. (published on page 231 of this number of MACHINERY); and "The Rockwell Dilation Method for the Heat-treatment of Steel," by Stanley P. Rockwell, Hartford, Conn. (published on page 147 of October MACHINERY).

TABLE 2. VALUES OF Y (14½-DEGREE INVOLUTE)

No. of Teeth	Y	No. of Teeth	Y	No. of Teeth	Y
12	0.067	20	0.090	43	0.110
13	0.070	21	0.092	50	0.112
14	0.072	23	0.094	60	0.114
15	0.075	25	0.097	75	0.116
16	0.077	27	0.100	100	0.118
17	0.080	30	0.102	150	0.120
18	0.083	34	0.104	300	0.122
19	0.087	38	0.107	Rack	0.124

Machinery

The Inspection of Disk Gear-cutters

In the report adopted as recommended practice for the inspection of disk gear-cutters submitted by the inspection committee, the following recommendations were made:

1. *Hardness*—This may be tested by any of the standard hardness testing instruments and by file.

2. *Bore*—Check diameter and roundness by use of plug or micrometer gages. Check keyway size and alignment by use of plug.

3. *Wobble*—Check sides for running true; also form of cutter for wobble. Use standard centers with indicator attached, having cutter mounted on suitable shoulder arbor.

4 *Concentricity and Radial Sharpening*—This may be checked on standard testing fixtures especially built for this purpose. Cutter to be rotated against indicator for concentricity, and the radial accuracy tested by using finger on the fixture provided for this purpose.

5. *Form Central*—Single finishing cutters may be checked on standard centers with indicator. Cutter is mounted on shoulder arbor, and indicator reading taken. Cutter is then reversed on arbor and should show same indicator reading.

6 *Tooth Form, Thickness*—This may be tested with standard tooth calipers. Care should be taken to make the necessary chordal and perpendicular allowances in making this check. (See any standard table on gears or gear-cutters.) If cutters have hooked teeth or are made with side clearance on form, special allowance (which will be furnished by cutter manufacturer), must be made when using tooth calipers.

7. *Tooth Form, Lantern Method*—By use of a projecting lantern, compare the tooth form with a predetermined form constructed from a cutter that has been proved satisfactory. Select a magnification sufficient to insure the desired accuracy, and keep the form being tested near center of lens.

8. *Tooth Form, Gage Method*—Test by the use of adjustable templets from No. 1 to No. 8, having the correct form for each range of teeth; templets to be adjustable in parallel plane to take care of variations in width of form (see Fig. 1).

Horsepower of Non-metallic Gearing

The committee on non-metallic gearing presented a report indicating that a great deal of experimental data had been collected, as well as a considerable amount of work spent on computing tables and formulas. Records of impact, compression, transverse, and deflection tests on non-metallic gearing materials were submitted. A valuable part of the report included formulas and tables for computing the horsepower of non-metallic spur gears composed of laminated phenolic materials or rawhide. In this report, the following formula for computing horsepower was given:

$$\text{H.P.} = \frac{0.000095 \times S \times FW \times Y}{DP}$$

in which

H.P. = horsepower;

S = safe working stress of material (varies with speed, see values of S in Table 1);

FW = face width in inches;

Y = a constant depending upon number of teeth (see values of Y in Table 2); and

DP = diametral pitch.

The formula is based upon the assumption that 6000 pounds is a safe working stress for static load. The values of S in Table 1 are computed from the formula

$$S = 6000 \times \frac{600}{600 + PLV}$$

in which

PLV = pitch line velocity in feet per minute.

Steel Castings for Gears

The following recommendations for steel castings for cut gears were accepted as recommended practice by the association. Steel castings for cut gears should be purchased on the basis of chemical analysis. Only two types of analysis are used, one for casehardened gears, and the other for both untreated gears and those that are to be hardened and tempered. The analyses are given in the following. The steel is to be made by the open-hearth, crucible, or electric furnace process. The converter process is not recognized, and its use is to be permitted only by individual arrangement between the interested parties. The following detail requirements are made.

Discard—Sufficient risers shall be provided to secure soundness and freedom from undue segregation. Risers shall not be broken off the unannealed castings by force. Where risers are cut off with a torch, the cut shall be at least one-half inch above the surface of the casting, and the remaining metal removed by chipping, grinding, or other non-injurious method.

Heat-treatment—All steel castings for gears must be thoroughly normalized or annealed, using such temperature and time as will entirely eliminate the characteristic structure of unannealed castings.

Chemical Composition—The chemical composition of steel castings for casehardened gears shall be as follows: Carbon, from 0.15 to 0.25 per cent; manganese, from 0.40 to 0.60 per cent; phosphorus, 0.06 per cent max. in acid steel, and 0.05 per cent max. in basic steel; sulphur, 0 06 per cent max.

For untreated or hardened gears, the composition shall be as follows: Carbon, from 0.30 to 0.40 per cent; manganese, from 0.40 to 0.60 per cent; phosphorus, 0.06 per cent maximum in acid steel, and 0.05 per cent maximum in basic steel; sulphur, 0.06 per cent maximum.

Ladle Analysis—An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements specified. This analysis shall be made from drillings taken at least one-quarter inch beneath the surface

TABLE 3. HORSEPOWER-PER-REVOLUTION CONSTANTS FOR WORM-GEARING
(For One Pound Normal Tooth Pressure per Inch of Active Face of Gear)

Linear Pitch	Single Thread	Double Thread	Triple Thread	Quadruple Thread
1/4	0.000000535	0.000001070	0.000001335	0.000001779
5/16	0.000000764	0.000001528	0.000001947	0.000002596
3/8	0.000001031	0.000002062	0.000002668	0.000003557
1/2	0.000001757	0.000003514	0.000004449	0.000005932
5/8	0.000002674	0.000005348	0.000006951	0.000009268
3/4	0.000003667	0.000007334	0.000009677	0.000012903
1	0.000006417	0.000012834	0.000016906	0.000022541
1 1/4	0.000009932	0.000019864	0.000026139	0.000034852
1 1/2	0.000013981	0.000027962	0.000036705	0.000048940
1 3/4	0.000018718	0.000037436	0.000049052	0.000065402
2	0.000024448	0.000048896	0.000064068	0.000085424

Machinery

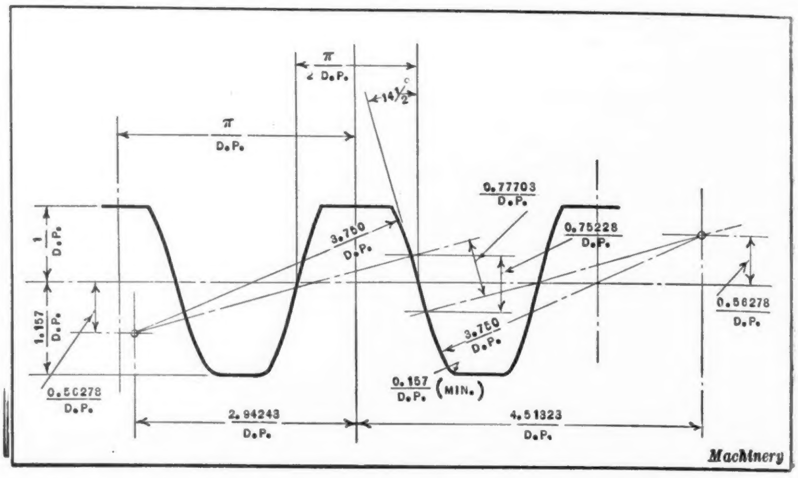


Fig. 3. Approximation of Basic Rack in Fig. 2, more easily reproduced in Templet or Cutter Form

of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified.

Check Analysis—Analyses may be made by the purchaser from one or more gear blanks representing each melt. The chemical composition thus determined shall conform to the requirements specified above. Drillings for analysis shall be taken at any point not closer to the center than midway between the center and the surface, but not within one-quarter inch of the surface of the casting.

Finish—(a) The castings shall conform substantially to the shapes and sizes indicated by the patterns or drawings submitted by the purchaser. When dimensioned drawings are provided, the foundry shall take all responsibility for correctness as to shrinkage. (b) The castings shall be free from injurious defects and have a workmanlike finish. Defects that do not impair the strength of the castings may, with the approval of the purchaser or his representative, be welded by an approved process. The metallic electrode method of electric welding is an approved process. No welding shall be done in such a manner as to conceal defects. The defects shall be cleaned out to solid metal before welding, and when so required by the inspector, shall be submitted to him in this condition for his approval. All steel castings welded by the foundry shall be heat-treated after welding before delivery to purchaser.

Marking—The melt number and foundry symbol shall be legibly stamped or cast on each casting 6 inches or over in thickness or diameter, and on castings of smaller section when so specified.

Inspection—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the castings ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the castings are furnished in accordance with the specifications. (b) If in the case of important castings for special purposes, surface inspection in the green state is required, this shall be so specified in the order. (c) All tests (except check examination for analysis and annealing) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection—Castings that show injurious defects or fail to pass check examinations subsequent to their acceptance at the manufacturer's works shall be rejected and the manufacturer shall be notified.

Rehearing—Samples tested by the purchaser, which represent rejected castings, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

Interchangeable Gears Made by the Modified 14 1/2-degree Involute Curve System

The tooth-form committee submitted a report, adopted as recommended practice, relating to the form of the basic rack for a 14½-degree involute curve system. Figs. 2 and 3 show this basic rack. Fig. 2 represents the mathematical definition of the basic rack, and Fig. 3 a very close approximation of the basic rack shown in Fig. 2. The form shown in Fig. 3 is more easily reduced to templet or cutter form than that shown in Fig. 2. Mr. Waterman of the Brown & Sharpe Mfg. Co. has advised the committee that the basic rack for a 14½-degree involute standard presented in Fig. 2, including the suggestions for clearance allowance, shows substantially the Brown & Sharpe system, which has been the basis for the manufacture of the Brown & Sharpe gear-cutters for many years. It should be clearly understood that it is not claimed that this basic rack will generate gears known as Brown & Sharpe gears, but gears generated with this rack will run well with what are known as Brown & Sharpe gears, and will correctly interchange with each other—that is, the rack shown is a true basis for an interchangeable system from a 12-tooth pinion to a rack.

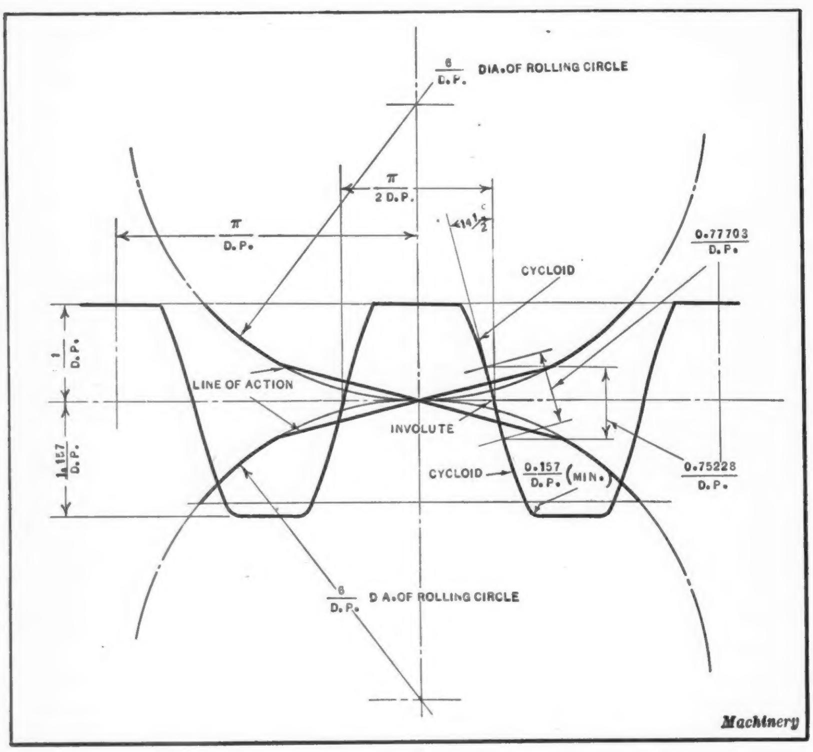


Fig. 2. Standardized 14½-degree Basic Involute Rack

Horsepower of Worm-gearing

The worm-gear standardization committee presented a table of constants for horsepower per revolution, for one pound normal tooth pressure per inch of active gear face, by means of which the horsepower of worm-gearing may be calculated. A formula was also presented showing how these constants may be used for horsepower calculations. It was pointed out that the allowable pressure

per inch of active face should be varied with the materials from which the gears are made; the speed at which they operate; characteristics of the lubricating medium; quantity and means for cooling the lubricating medium; quality of workmanship in manufacturing, and care in installing the gears; and the nature of the service—that is, whether the gears operate continuously or intermittently. Using the constants in Table 3, the horsepower of worm-gearing may be calculated by the following formula:

H.P. = constant from table × R.P.M. of worm × allowable pressure per inch of worm-gear face

Example—If the operating conditions are such that a tooth pressure of 500 pounds per inch of face is permissible, what horsepower will a triple-thread, 1-inch linear pitch worm transmit at 600 revolutions per minute?

H.P. = 0.000016906 × 600 × 500 = 5.07 horsepower

To determine the proper size of worm when the horsepower, the revolutions per minute, and the allowable tooth pressure per inch of face are known, the following formula may be used:

$$\frac{\text{H.P.}}{\text{R.P.M.} \times \text{allowable tooth pressure}} = \text{constant in table}$$

The constant having been determined in this way, the nearest value is found in the table, and the type of thread and the linear pitch may thus be determined.

Report of the Membership Committee

The following new members were elected: Lewis Foundry & Machine Co., Pittsburg, Pa., with John Lucas as executive representative; Ferguson Gear Co., Gastonia, N. C., with Richard Ferguson as executive representative; Timing Gear Corporation, Chicago, Ill., with R. O. Bauman as executive representative; and Alfred Wiseman, Ltd., Birmingham, England, with J. W. Harris as executive representative. John Lundberg was elected an associate member from the Tool Steel Gear & Pinion Co., Cincinnati, Ohio.

* * *

RECENT TESTS ON THE EFFICIENCY AND DURABILITY OF GEARING

An extensive series of tests on gearing has recently been carried out by Professor C. W. Ham of the University of Illinois and Professor J. W. Huckert of the University of Louisville, using a testing machine designed and built by Wilfred Lewis. The results of these tests were summarized in a paper presented by Professor Ham before the American Gear Manufacturers' Association at West Baden, Ind., Oct. 2.

Considering tooth friction only, the following conclusions were drawn from these tests in regard to efficiency:

1. The efficiency of unhardened gears is practically independent of the quantity of oil used for lubrication, provided the quantity is sufficient to prevent heating and cutting.

2. The efficiency is independent of the speed within the range covered by this investigation, namely, a pitch-line speed of 60 to 1500 feet per minute.

3. The efficiency does not appear to be influenced by the obliquity of action.

4. For all practical purposes, the efficiency is independent of the load transmitted. The value of 99 per cent is suggested for use in computations dealing with the efficiency of unhardened gears cut in accordance with good commercial practice.

5. The condition of the tooth surface is the most important of the factors that affect the efficiency of unhardened gears. Gears with rough tooth surfaces are less efficient than those in which the tooth surfaces have become glazed, but the difference in efficiency is not so great as has been commonly assumed.

6. When all other conditions are the same, greater sliding action causes the longer addendum gears to have a slightly lower efficiency than the shorter addendum gears. On the other hand, the vibration of the longer addendum gears may, for certain ratios, be so much less than that of the shorter addendum gears as to result in a slightly higher efficiency of the long addendum gears.

7. The difference in efficiency of the several standard tooth forms in common use is so small as to exercise no controlling influence on the tooth form to be recommended or adopted for any purpose.

Summary of Conclusions in Regard to Durability

1. Unhardened steel pinion teeth quickly wear to outlines other than true involutes, regardless of load, speed, and lubrication; and after this occurs, wear practically ceases or is greatly retarded under ordinary operating conditions.

2. The teeth of cast-iron gears meshing with steel pinions fail by crushing of the material in the region of the pitch line.

3. The teeth of unhardened steel pinions meshing with cast-iron gears fail by abrasive action, which wears off the face of the tooth and hollows out the flank, resulting, in general, in a final outline of double curvature.

4. Lubrication is a very important factor in the life of unhardened gears. Although the quantity of lubricant does not materially affect the final change in tooth outline due to wear, it postpones the beginning of a rapid wear of both pinions and gear, and thus greatly prolongs the life of the gears.

5. Under the same conditions of load, speed, and lubrication, the wear increases with greater sliding action, but these tests indicate that the amount of sliding and the amount of wear are not necessarily proportional.

6. Combinations of factors or conditions that cause excessive vibration have a detrimental effect on the durability of gear teeth.

7. Surface pressure is the most important of the factors that affect durability. Apparently, for any pair of gears, there is a critical surface pressure, governed by the properties of the material, above which the life of gears is short, and below which the gears will run indefinitely without appreciable wear.

8. For unhardened gears under constant load and free from impact loads, the allowable tooth loads based on the Lewis formula for strength are larger than those permissible for satisfactory durability.

9. Unhardened gears for constant load transmission should be designed on a basis of durability rather than of strength. A gear tooth that is durable for a given load will, in general, be amply strong.

* * *

MEETING OF AMERICAN WELDING SOCIETY

The American Welding Society held its fall meeting October 21 to 23 at the Massachusetts Institute of Technology, Boston, Mass. On the first day papers were read on "Thermit Welding," by J. H. Deppeler, chief engineer, Metal & Thermit Corporation, and on "Gas Welding of Power Plant Piping," by A. W. Moulder, chief engineer of the Grinnell Co. The second day a joint paper was read by H. M. Hobart, chairman, and W. Spraragen, secretary of the electric arc welding committee, on "Industrial Applications of Arc Welding and Economies Effected Through its Use." A meeting of the American Bureau of Welding, which is the research department of the American Welding Society, was also held. The program included a review of present activities of the research department, and future investigations were outlined. During the last day of the meeting a series of short addresses by several prominent engineers were made on "Selection of Materials for Welding." J. W. Meadowcroft, general supervisor of welding of the E. G. Budd Mfg. Co., also read a paper on "Manufacture of All-Steel Automobile Bodies," illustrated by moving pictures. A special exhibition and demonstration of welding and cutting applications was included in the program.

Current Editorial Comment

in the Machine-building and Kindred Industries

TESTING LABORATORIES PAY

Twenty years ago few metal-working plants had their own testing laboratories. If occasionally it was deemed desirable to test the strength of a piece of metal or to determine its chemical composition, it was either sent to the laboratory of an engineering school or to a consulting chemist.

Now, laboratories equipped to make physical and chemical tests on materials are found in many plants, although many managers regard the maintenance of such a laboratory as an unnecessary refinement and an unwarranted expense. In this opinion they are frequently mistaken. Shop laboratories have proved to be paying propositions in almost every instance where they have been installed.

A plant engaged mainly in the manufacture of threading tools, until recently had never recognized the need and value of a laboratory. It maintained a rigid inspection of the finished product; but due to the changes of lead and pitch diameter in hardening and other defects that did not become apparent until after heat-treating, it was found necessary to reject about twenty per cent of the product in the final inspection after hardening. This was considered an unavoidable difficulty, and an expense due to the character of the business.

A change in management brought about the introduction of more modern ideas. A testing laboratory was installed, and all the steel entering the plant is now chemically analyzed, and etched and studied under the microscope. In this way defective steel is eliminated before any work has been performed upon it. The results have been most astonishing. The rejections after hardening have been reduced from twenty per cent to less than one per cent of the product. The money spent on equipping the testing laboratory is an investment that pays big dividends.

* * *

SCIENTIFIC MANAGEMENT

Following the notable research work of Frederick W. Taylor and others interested in industrial development, the "scientific" system of management was utilized in numerous manufacturing plants. Elaborate systems for controlling manufacturing processes were installed in many shops and factories, and the technical press frequently contained articles featuring this new plan of management. Publishers also produced various text-books written by specialists, and apparently the methods of managing industrial plants were to be revolutionized. But comparatively little is heard about scientific management now, and it might be inferred by those who are not closely in touch with manufacturing practice that the new plan has been discarded. While it is true that the rather elaborate expression "scientific management" is not used as often as it was, it is important to note that the fundamental principle remains and has proved its worth.

Some firms in their enthusiasm for this new idea installed extensive filing or other systems which required additional overhead that more than offset the results obtained, so that "the tail wagged the dog." But it was soon recognized that expense is expense, whether it applies to card files and clerks or to manufacturing processes, and wherever systems were not self-supporting and profit-producing they soon disappeared. The fundamental principles laid down by Mr. Taylor and other pioneers will continue to be applied, because they provide means of producing more with the same amount of energy and equipment, by standardizing manufacturing practice up to the level of the most effective known methods. Industry in general acquired an asset of inestimable value when this principle of conservation and standardization was placed upon a practical working basis, and if a complete history of scientific management could be written, it would present a striking illustration of the value of a great idea.

* * *

INVENTORS AND DESIGNERS

It is well known that many patents do not bring the inventor sufficient return even to pay the patent office and attorney's fees; but there are many people whose principal occupation appears to be "inventing." These professional inventors have to some extent brought the words "inventor" and "invention" into disrepute, and many engineers who have made notable contributions to the development of machines and mechanisms used in the industries prefer to be known as designers rather than as inventors.

One man whose name is well known in the machine tool field, in referring to the many developments for which he is responsible, made the request that they be not referred to as inventions, and that he be not classed as an inventor. "I design machinery," he said. "In this work I have occasion to develop many new mechanisms on which I have obtained numerous patents; but after all, these mechanisms are only incidental to the complete design of the machines for which I am responsible and which have been instrumental in building up my business. I am a designer of machinery, not an inventor."

Many inventors would receive greater returns if they would work along similar lines—that is, apply their ability and energy principally to the design of new and improved machinery and equipment, rather than to the invention of what appeals to them as an epoch-making novelty. As a rule, the designer performs a much greater service through steady painstaking work than the inventor.

* * *

PRELIMINARY INSPECTION IMPORTANT

In most plants, when a machine has been set up to produce parts in quantity, the operator refers one of the first pieces made to the foreman, who measures and approves the part; but seldom are the first parts made submitted to the inspection department for approval before production is started.

In a plant recently visited, the latter practice is followed and has proved to be very economical. After the machine is set up and the first pieces made, it is stopped and the parts brought to inspectors located near the department. They immediately put the parts to every test required in the final inspection, and not until their approval has been obtained may the operator start up the machine and go ahead with the production. In this plant about one-fifth of the parts made on automatic screw machines and other automatic machines with special tooling equipment, where a number of operations were performed on the same piece, had to be rejected in the final inspection. By subjecting the first pieces coming from each machine to a rigid inspection, and by similar inspections of a few pieces from time to time during the production run, it has been possible to maintain so high a quality that there are practically no rejections in the final inspection.

The cost of having the product inspected in this way is greater; but the saving of nearly one-fifth the total output that formerly became scrap leaves a comfortable margin to the good.

RESURFACING COMMUTATORS

By H. A. FREEMAN

The commutator of a direct-current motor or generator is sometimes a flat disk, but it is more commonly a cylindrical drum consisting of copper segments, each insulated from the other by mica plate. This plate is composed of flakes of mica, stuck together with a binder, and pressed, baked, and ground to form a sheet of uniform thickness.

Sparking and the current-carrying brushes which rub on the commutator will cause the commutator to become scored, thus necessitating resurfacing from time to time. When in the best condition, a commutator surface has the appearance of a piece of highly polished mahogany, and it should not be touched, or, at most, only wiped off with a clean, soft piece of cloth when in this state.

Removing Spots on Commutator

When rough spots first appear on the commutator surface, they may be removed by stoning with blocks of soft sandstone, such as are carried especially for this purpose by

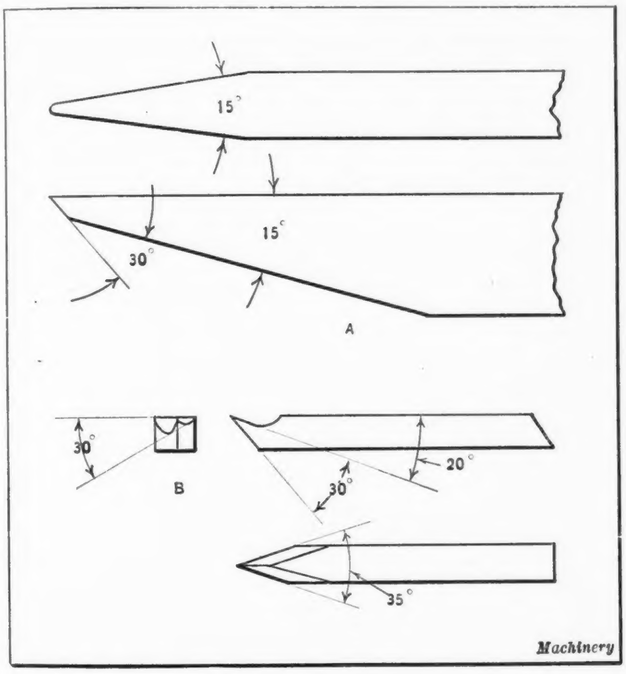


Fig. 1. Tools for turning Commutators

electrical supply stores. If a stone is not available, the commutator may be rubbed with medium fine sandpaper. Emery cloth should not be used as the emery will separate from the cloth and become embedded in the copper bars, causing considerable trouble.

When the commutator is badly pitted or worn, it should be turned to a true cylindrical shape. The writer has seen many poor jobs of commutator turning done by otherwise good mechanics, simply because they did not know how to sharpen the tools. Tools for turning commutators should have a certain degree of tangential resilience, as distinguished from the radial resilience of the ordinary spring tool. To obtain this quality, the tool is drawn out to a long taper, as shown at *A*, Fig. 1, with a clearance ground as indicated and the top ground flat.

For small work, such as is ordinarily done in a bench lathe, the tool is ground differently, as indicated in the view at *B*, although if the shafts are not too long and cannot be easily sprung, a miniature tool similar to the one shown at *A* could be used. After the commutator has been turned, it can be polished slightly with fine sandpaper, and it is then ready for the under-cutting operations. It is important that the work be done dry with high cutting speeds and light feeds.

In the early days of electrical machinery, commutator bars were insulated with pure amber mica which had about the

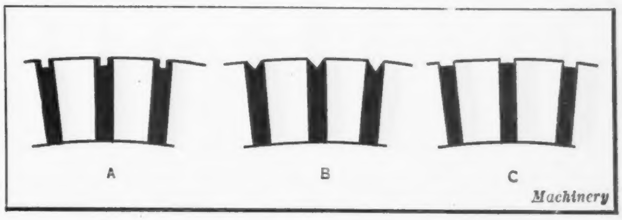


Fig. 2. Different Forms of Under-cut used for Mica Insulation

same wearing qualities as the copper used in the commutator segments. Such commutators, when properly finished to a cylindrical form, retain their finish under action of the brushes. At present pure amber mica is very expensive and exceedingly difficult to obtain. In its place are used built-up sheets made from plates or lamellæ 0.002 to 0.004 inch thick of both amber mica and the harder kind of mica stuck together with some gum or resin. Both the white mica and the baked binder are harder and more resistant to wear than the copper commutator segments, which results in the copper wearing off and leaving the mica projecting. This condition is what the electrician terms "high mica."

In order to prevent the "high mica" condition, the mica is generally grooved or under-cut between the segments or bars, as shown at *A*, and *B*, Fig. 2. Theoretically, the style of under-cut shown at *A* is the better, although its superiority is probably more imagined than real. The condition shown at *C*, Fig. 2, should be avoided, although it is not of such serious consequence as was once believed, except in the case of large, slow-speed machines, or machines operating in places where dust of a current-conducting nature is prevalent. The under-cut is best done when the entire brush contact area is grooved without having the grooves run out on the end of the commutator. Ordinarily, the grooves should be about 1/32 inch deep.

Tools for Under-cutting Mica Insulation

Among the tools used for under-cutting the mica insulation are the three-cornered file with the tip broken off, jewelers' riffles, and the devices shown in Fig. 4. At *A* is shown a piece of hacksaw blade having one end wound with friction tape to serve as a handle. The continued use of this tool causes the hands to become cramped, but it is easily made and can often be used to advantage. The tool shown at *C* consists of a piece of hacksaw blade fitted into a wood or fiber holder, where it is clamped with-flat-headed screws or nuts. It is sharpened by merely snapping off the tip of the blade.

It is a good practice to stone off a little of the "set" from the saw blades when they are used for grooving or under-cutting the mica insulation, so that they will not cut sideways and produce the effect shown at *C*, Fig. 2. At *B*, Fig. 4, is shown what is termed a "pull-hook," which is made from a piece of drill rod, forged and sharpened as shown. As a guide for starting the cut when grooving, there is probably

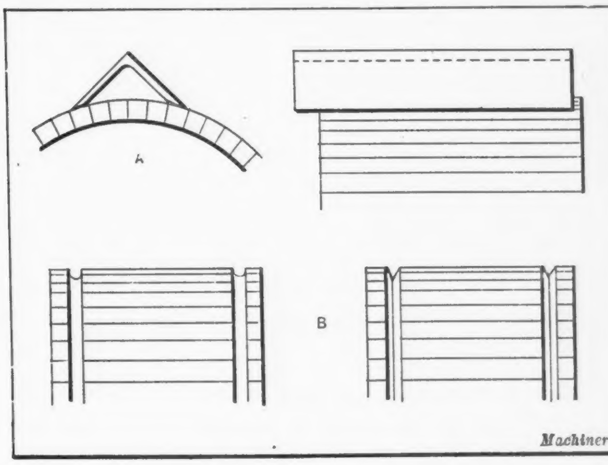


Fig. 3. (A) Using Angle-iron as Guide in starting Grooves in Commutators; (B) Grooved Commutators

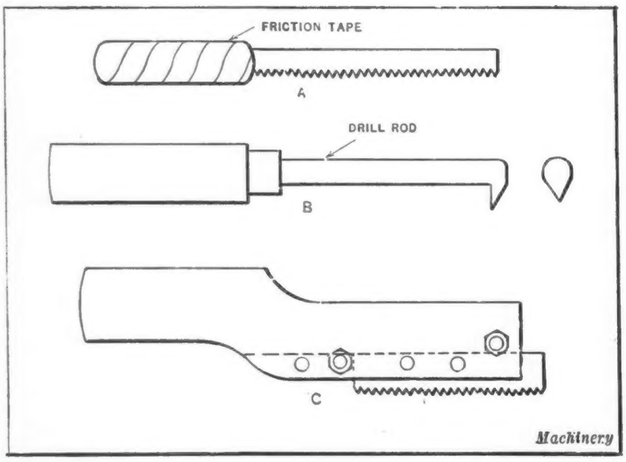


Fig. 4. Tools used in under-cutting Mica

nothing better than an old keyseat rule. For larger commutators, a piece of commercial angle-iron may be used, it being preferable to remove some of the outside radius, as indicated in the view at *A*, Fig. 3. On some commutators there are semicircular or V-shaped annular grooves, such as shown in the lower views of Fig. 3. Commutators having grooves of this kind are to be under-cut only between the grooves. It may be well to emphasize here the importance of removing as little metal as possible when resurfacing a commutator.

* * *

STANDARDIZATION OF RAILROAD SHOP TOOLS

At the recent convention of the American Railway Tool Foremen's Association in Chicago, a committee appointed to consider the economies possible by the standardization of tools, with A. G. McKernan, supervisor of tools of the Atchison, Topeka & Santa Fe Railway Co., as chairman, submitted a report in which it was pointed out that considerable savings could be obtained if the railroads would standardize upon the tools most generally used, especially flange forming tools for locomotive and car shops; locomotive taper reamers; gages; lathe and planer tools; and methods of repairing air hammers, air drills, jacks, and chain hoists. Tools ought to be repaired at a central point where proper supervision is available. Lathe, planer, and shaper tools ought to be heat-treated by specified methods, and ground to standardized gages. By the use of gages in grinding, it is possible to obtain proper clearance, top and side rake, and to increase production from 25 to 100 per cent over the old methods, as well as to reduce, to a material extent, the amount of high-speed steel used annually.

Results Obtained by Standardization

As an example of what can be accomplished by standardization of equipment and methods of repair, the committee mentioned that in a shop where a large number of air hammers were repaired, during 1924, the repair charge was reduced to 42 cents per month per tool. For air drills, this cost was 70 cents per month per tool, in a shop where 2500 tools were repaired in a year. By similar standardization of repair methods and a centralized repair shop, the cost of repairing jacks was reduced to 38 cents per jack per month. This charge covers labor, material, and overhead. A creditable reduction in the cost of twist drills has been made by the use of sockets and sleeves that make it possible to use up drills with broken shanks. One railroad has reduced its twist drill cost approximately 25 per cent in this way.

The committee recommended that, wherever possible, threads, tapers, length of reamers, the making of lathe and planer tools, etc., should be standardized, so that all railroads may use practically the same standard tools. If this were done, the manufacturers would have an opportunity to standardize their product and to carry in stock tools suitable for all railroads. This, in turn, would permit the railroads to purchase tools at a lower price than is now the case, because at present many railroads call for tools that are special and used by no other railroad than the one placing the order. Evidently, the manufacturer must charge more for such tools.

The Question of Homemade Tools

Referring to the practice of making tools in the locomotive shops, where costs are in many cases greater than the cost of tools purchased from manufacturers, the committee recommended that the railroad shops should make only such tools as cannot be bought in the open market and are considered more or less special. If tools were standardized as proposed, then certainly no railroad shop could make them cheaper than the manufacturer. This, in turn, would relieve the locomotive tool-room of a considerable amount of work, and the time of the men in these shops could be utilized to better purposes than for making tools that are of standard quality, or that could easily be made standard, if the railroads would agree upon standard specifications.

How Tool Standardization Would Aid the Railroad Shop

In a paper presented before the convention, L. J. Franks, tool-room foreman of the Erie Railway, at the Hornell Shops, Hornell, N. Y., also called attention to the need for standardization of tools in locomotive and car shops, and especially emphasized the need for reducing expense by standardization of machine shop equipment.

"Take the lathe, for example," said Mr. Franks. "Expenses can be reduced if lathes are equipped with chucks of one make, in as few sizes as possible. This allows the railway shop to carry supplies of jaws and chucks at minimum cost and to keep chucks in good repair without adding a great deal to the stock of repair parts. Another item that ought to be considered is the different sizes of tool steel required for tools for different machines. High-speed steel especially runs into a great deal of money, and a large supply of it on hand, in different sizes, adds considerably to the expense of operating the shop. The requirements in the railroad shop ought to be carefully studied and the number of sizes of steel kept on hand for tools reduced to a minimum. A big saving can be effected by eliminating all unnecessary sizes."

Mr. Frank also advocated that each railway shop standardize on certain lines and types of pneumatic tools, chain hoists, jacks, and other tools and equipment, so as to save money on the number of repair parts that need to be kept in order to keep the tools in first-class condition. If there is no standardization, but equipment of all makes and types are scattered throughout the shop, the stock-carrying charges for repair parts become much higher than necessary.

* * *

INDUSTRIAL CONDITIONS IN AUSTRALIA

Since October, 1924, Australia has been passing through a very dull period in the industrial field. The present depression will doubtless continue until early in 1926, when a revival in business is expected. The larger part of the machine tool and small tool requirements of Australia are met by the United States. Practically every type of machine tool and other shop equipment, except highly special machines, find use in some Australian plants, the general tendency being to model Australian machine shops after well planned American shops.

There appears to be a great deal of capital in Australia seeking investment in industrial undertakings, but before doing so, capital always ask for tariff protection. Representatives of American manufacturers in Australia are opposed to these exceptionally high tariffs, because their purpose is to shut out imports from the United States and other foreign countries; and the effect, according to a leading Australian machine tool dealer, will be to increase considerably the cost of all articles manufactured in Australia.

Notes and Comment on Engineering Topics

A new development in the application of electricity was shown for the first time at the eighteenth annual electrical and industrial exposition held in the Grand Central Palace, New York City, October 14 to 24. This is a new heating device for domestic purposes, which makes it possible to cook or bake with the heat of ordinary electric light bulbs.

After ten years of research just completed at the Bureau of Standards, Washington, D. C., it has been proved by experiments that finely ground cement makes stronger concrete than less finely pulverized cement, especially in rich mixtures where the amount of cement used is greater in proportion to the sand and gravel than is ordinarily employed.

A material which is claimed to be capable of replacing diamonds in core drilling and stone cutting has recently been developed in Germany. This material is said to have a melting point of over 5400 degrees F., and consists of a mixture of tungsten carbide and tungsten, being known under the trade name "Phoran." It does not soften or fuse at temperatures below the melting point, and possesses a hardness on the Moh scale between 9.8 and 9.9, the diamond on this scale having a hardness of 10.

How engineering research aids in making possible cheaper construction and the elimination of waste is well exemplified in the case of savings made in highway building. Engineering study of road construction has developed a design using a thickened edge for concrete roads. By this design there is an estimated saving in building concrete roads of approximately $3900 per mile. Twenty-four states are said to have adopted this new design for their state highways.

The Bureau of Mines has recently tested and approved of a new type of totally enclosed motor especially adapted for use in gaseous mines. When the cover is removed from the controller, all circuits are automatically cut off except the two shielded terminals of the incoming line. It is thus impossible to accidentally start the motor or to draw an arc with the controller cover removed. By means of this construction, no heat can be transmitted to the outside of the motor in such intensity as to ignite any gases surrounding the equipment.

According to an exhaustive report on the properties of tungsten, compiled by W. E. Forsythe and A. G. Worthing of the Nela Research Laboratory of the General Electric Co., the melting point of tungsten is 3655 degrees C. on the absolute scale, which would be equivalent to about 6125 degrees on the regular Fahrenheit scale. The melting point of tungsten is the highest of any substance known, with the possible exception of carbon. The specific gravity of tungsten is 19.3 at room temperature. Whether or not the density changes slightly with continued drawing is uncertain.

In an article in *Comptes Rendus*, an apparatus designed for obtaining unusually high rotative speeds is described. The experimenters devised a motor operated by compressed air in which the rotating part was supported by the escaping gas, thereby avoiding friction and at the same time leaving the rotor perfectly free to select its own axis of rotation. This rotor, which was approximately 1/2 inch in diameter, was run for hours at a speed of 4000 revolutions per second (240,000 revolutions per minute), and it was temporarily speeded up to 11,000 revolutions per second (660,000 revolutions per minute).

It is stated that by building up the worn flanges of street car wheels by electric welding, in the repair shops of the Detroit Street Railway System, an increase of about 20 per cent in the life of the wheels has been obtained. When the flanges are worn to a thickness of 5/8 inch or less, the wheels are removed from the cars and sent to the repair shop, where a continuous automatic electric welding machine is used for replacing the worn-off flange metal. The building up operation for one wheel is said to require, on an average, about an hour. The rough surface is then refinished on a car-wheel grinding machine.

Clay refractories furnished to the trade in their plastic form are rapidly supplanting special shapes in boiler settings and similar installations. Because of the increasing importance of this material, the total daily output of which exceeds 100 tons, and the fact that the government is contemplating the standardization of specifications for its purchase, the Bureau of Standards has recently made tests to determine the physical and chemical characteristics of several commercial brands of this material. The information obtained in these tests indicates that plastic refractories, as now furnished to the trade, are equivalent to the highest grade fireclay brick.

An electric lawn mower which, it is claimed, will be as easy to operate as a vacuum cleaner, has been developed. This device not only cuts the grass by electric power, but also propels the mower electrically. The motor obtains power through an 80-foot supply cable that can be attached to the nearest light socket. The cable is carried on a reel and is wound and unwound automatically, maintaining the proper tension at all times, whether going from or toward the source of power. The vital moving parts are enclosed in dustproof housings and run in oil. An electric switch is provided in the handle, and all that is necessary in operating the device is to steer or guide it.

Through the discussion and advocacy of standards of conduct and ethics, business organizations are taking part in the upbuilding of a new and growing sense of responsibility and self-government in our economic life and in the community at large. Self-government comprises more than political institutions. The growing complexity of our modern life requires that if self-government is to be a success there must be self-government among business groups. There are many problems of restraint of business abuse that can be solved by agreement among groups instead of by law. The arm of government is a poor cure for business abuse, for it becomes at once a restraint of liberty.

The safeguard against the invasion of government into the lives and liberties of our people is that we shall cure abuse outside the government. A trade association, in the erection of ideals, in the determination of methods and definitions of standards for the elimination of abuse, is self-government in the greatest form of which democracy has yet given conception—that is self-government outside of government.—*Herbert Hoover*

CENTER OF GRAVITY

The center of gravity may be defined as the point at which the weight of a body is concentrated. Under the influence of gravity, all the particles of a body are attracted toward the earth's center, and each is acted upon by a separate force; but the resultant of all these separate forces passes through a point upon which the whole attractive force may be considered as concentrated. This point is the center of gravity.

HAND TAPS

Hand taps are the most commonly used of all taps. They are usually made in sets of three, termed "taper," "plug," and "bottoming" taps. When all three taps are employed for tapping a hole, they are used in the order named. The term "taper tap," when used to designate the first tap in a set of three hand taps, should not be confused with the term "taper tap" as properly used for a tap the threaded portion of which is conical. The point of a taper tap in a set of hand taps is turned down to the diameter at the bottom of the thread for a length of about three or four threads. This turned-down portion acts as a guide, tending to produce a straight hole. From the upper end of the guide, about six threads are chamfered or tapered until the full diameter of the tap is reached. The remaining part of the threaded portion of the tap is turned straight or parallel. On the plug tap, three or four threads are chamfered at the point, and the remaining portion of the thread is turned parallel. On the bottoming tap, only about one thread is chamfered. The diameter of the straight portion of the thread of all the taps in the set is the same, in the regular type of hand taps. Taps are made in sets, however, in which only the bottoming tap is of the full diameter, while the other taps gradually decrease in diameter, so as to distribute the work between the three taps.

POWER FACTOR

In an alternating-current circuit, the electromotive force and the current may or may not be in phase, and the difference in phase determines the "power factor." The power factor is the ratio of the real power to the apparent power. This ratio is generally less than 1, and can never be greater. When the current leads the electromotive force, the power factor is not greater than unity, but is distinguished from that caused by lagging current by calling it "leading" power factor.

SPACING TABLES FOR PUNCHING MACHINES

In order to avoid laying out rivet holes in plates prior to punching, spacing mechanisms are often used in conjunction with punching machines. The plate or other part to be punched is carried by a table that is shifted an amount equal to the spacing required between the holes. This spacing table may have either a hand or automatic feed. The mechanism of an automatic spacing table is so designed that the table is shifted as soon as the punch has moved up far enough to clear the work, the movement being completed before the punch again engages the stock. For girder work, where the rivet spacing may vary in each row, the problem of spacing is more difficult than in the case of boiler work, where the spacing is uniform on each seam. Mechanical spacing devices for girder work may be partly automatic so that the machine continues a given spacing until it is changed by the operator or the machine may follow a templet previously set for the required spacing and be entirely automatic.

DIE-CASTINGS WITH INSERTS

Die castings are often made with steel or brass inserts. These inserts are placed in the die at the time of casting, and the process involves no special feature except that the inserts are usually knurled or provided with some other means of anchoring them in the molten metal. The principal purposes of inserts are: (1) To lend added strength; (2) to furnish electrical or mechanical properties; and (3) to simplify assembly. A common practice is to cast inserts at specific points to provide bearing surfaces. This is often done in housings for magnetos. The magneto housings are also sometimes of such design that special means for lubricating are necessary, and it is common practice to cast in oil-tubes, bent in almost any shape, to provide accessibility for lubricating.

CALORIMETERS

Calorimeters are of two kinds, fuel calorimeters and steam calorimeters. Fuel calorimeters are used for determining the heating value of fuels. Steam calorimeters are used for determining the percentage of moisture in steam. A fuel calorimeter consist mainly of a closed chamber in which a previously weighed sample of the fuel can be rapidly and completely burned. A receptacle containing a predetermined amount of water surrounds this chamber, so that the heat produced by the combustion of the fuel is transferred to the water. A sensitive thermometer is then used for measuring the rise in temperature of the water. Special means must be provided for igniting the fuel, and provisions must be made for preventing loss of heat from the calorimeter by radiation or by the escape of the heated gases of combustion. The most commonly used calorimeter is that known as a "bomb calorimeter," also called "Mahler's modification of Berthelot's calorimeter."

Steam calorimeters are constructed in a number of different ways; one of those most commonly used consists of a half-inch pipe closed at one end and perforated with several 1/8-inch holes in its walls. This pipe is inserted into the main steam pipe so that the steam can enter through the small holes. The other end of the pipe is throttled by an orifice 1/16 inch in diameter, through which the steam escapes into a chamber having an outlet to the atmosphere. The temperature and pressure of the steam on each side of the orifice are then observed. The action of the instrument depends upon the fact that the heat of saturated steam increases with the pressure, and, consequently, if the pressure is reduced by the throttling effect of the orifice, the heat liberated will convert the moisture into steam and produce superheating. The steam in the chamber mentioned is superheated according to the amount of moisture contained in the steam passing into the half-inch pipe from the main steam pipe.

BELT CONVEYORS

Belt conveyors are used for carrying and transporting coal or sand, gravel, etc., comparatively short distances. These conveyors combine a high carrying capacity with low power consumption. The belt on which the material is carried is sometimes flat, the material being fed to it at the center in a narrow stream, but, in most cases, the belt is made to assume the shape of a trough by means of guiding idler pulleys set at an angle with the horizontal and placed at intervals along the length of the belt. Rubber and cotton belts may be used for belt conveyors. The speed at which belt conveyors are run varies from 200 to 800 feet per minute.

ELASTIC GRINDING WHEELS

Very narrow grinding wheels are made by the elastic process. Shellac is the principal ingredient in the bond, and the wheels made by this process are strong and have considerably elasticity, so that very thin wheels can be used safely. Wheels 1/32 inch thick are manufactured. Thin elastic wheels are used for slotting and for cutting off stock such as tubing, pipes, wire, thin sheets of tin or brass, and other materials, especially when the parts are difficult to hold for cutting with regular tools. Thicker elastic wheels are employed for saw-gumming, grinding the teeth of gears, sharpening wood-working tools, etc. They are also used for cutlery work and roll grinding, where a very smooth polished surface is desired.

COAL DUST AS FUEL

The fact that dust will burn with great rapidity accounts for the attempts to make use of pulverized fuel, which may be burned without smoke and with high economy. This fuel, instead of being introduced into the firebox in the ordinary manner, is first reduced to a powder by pulverization, and, in place of the ordinary boiler firebox, a combustion chamber is used in the form of a closed furnace lined with firebrick. This furnace is provided with an air injector having a nozzle which throws a constant stream of powdered fuel into the chamber, spraying it throughout the whole space of the firebox. This powder may be ignited by first raising the lining of the firebox to a high temperature by an open fire. The combustion of the powdered fuel then continues in an intense and regular manner under the action of the air current which carries it into the combustion chamber. It is probably the most economical method of burning coal as far as fuel efficiency alone is concerned. It is the most expensive method in regard to the auxiliary equipment and labor required and the necessity of various features being carefully looked after. The coal must have about 30 per cent of volatile matter and be pulverized to a certain degree of fineness in order to ignite satisfactorily. It cannot be stored for more than about a day without danger of spontaneous combustion. This makes necessary an elaborate system of conveyors to carry the coal from the pulverizers to the furnaces. In general, this is an impracticable system for small installations, but may be sufficiently economical to be very desirable for large installations.

SHEET STEEL

Sheet steel is made from soft steel containing a low percentage of carbon. The United States standard plate gage sizes most generally considered under the heading of "sheet steel" are those from No. 10 (0.141 inch thick) down to No. 30 (0.013 inch thick). Sheets corresponding to the various gage numbers between these limits are made in widths of 24, 26, 28, and 30 inches, and in lengths of 72, 84, 96, and 120 inches. Nos. 10 to 16, inclusive, are also made in widths of 36, 40, 42, and 48 inches, and in lengths of 144 inches, and Nos. 17 to 24, inclusive, are also made in sizes 36 inches in width and 144 inches long.

IRIDIO-PLATINUM

Iridio-platinum is an alloy of iridium and platinum, containing about 10 per cent of iridium and 90 per cent of platinum. The alloy is used for international weight standards, electrodes exposed to acid liquids, and wires forming part of high-temperature pyrometers. It is a remarkably hard alloy, susceptible of high polish. Very few chemical reagents attack it.

FOLLOWER

The name "follower" is often applied to the driven member of a gear train or other mechanism having a part that receives motion from another member and follows it; usually the "follower" in a train of mechanism is the last driven member. The follower of an engine piston of the sectional type is the plate or cover that serves to retain the piston-rings.

TRADEMARK

A trademark is an arbitrary sign, word, or symbol used to distinguish one manufacturer's product from that of another, and to impress a particular article on the mind of the public. The value of a trademark consists of an assurance to a manufacturer or merchant of protection in the exclusive use of the name, sign, or symbol, by which his product becomes known. The trademark is a guarantee of the genuineness of the marketed article, and may be said to be, in this respect, the commercial substitute for an autograph. The protective value of the trademark may be compared with the protection afforded by a fundamental patent, as the trademark is used not only in connection with patented articles but also with commodities not patented nor patentable.

A trademark must not in any way be descriptive of the product nor should it be in the least deceptive. For instance, if a trademark for a soap were claimed on the word "Magnetic," the claim would be rejected on two grounds. First, because soap could not be magnetic, and so the word would be deceptive and misleading, and second, because the term would be descriptive if correctly employed. A proper name, geographical term, or the name of cities, etc., also cannot be used at trademarks. The first letters in the words of a company's name are frequently used with the abbreviation of company. For example, a coined word such as "Seeco" is arbitrary and meaningless, and it would be proper subject matter for a trademark, provided it had not been used previously.

STRENGTH OF CHAIN

The ultimate, or breaking, strength of a chain is usually between 1.5 and 1.7 (average 1.66) times the ultimate strength of the straight bar or stock from which it is formed, instead of twice that amount, as might at first thought be expected because of the doubling of the bar in forming the link. The link of a chain under load is not in the simple physical condition of a bar under direct tension in a testing machine. A link is subjected to a direct tension, due to the load or pull, and to a bending moment that induces tension on the outer fibers and compression on the inner fibers of that part of the link subject to bending. The stress in tension due to bending may equal more than three (for stud links) or four (for open links) times that produced by the direct pull evenly distributed over the cross-sectional area of the bars.

RESISTANCE

Resistance is the property of a substance that opposes the flow of an electric current. The practical unit of resistance is the ohm, having such a value that an electromotive force of one volt will cause a current to flow through it at the rate of one ampere per second. The electrical resistance of a conductor varies directly with its length and inversely with its cross-sectional area. For metal conductors, it also increases with the temperature. The "specific resistance" is the resistance per mil-foot of a material; it is also sometimes termed "resistivity."

What MACHINERY'S Readers Think

on Subjects of General Interest in the Mechanical Field

THE NEW MAN IN THE MACHINE SHOP

As a rule, the average new man in the machine shop tries and wants to make good. He may feel lost for the first few days, but gradually, provided he likes his job, he begins to "fit in," and soon becomes an important part of the shop force. The first impressions that the new man receives nearly always determine whether he will like his job and stay, or whether he will just use it as a "tide-over" until something better turns up.

It has always been the writer's impression that not enough attention is paid to the new man in the average machine shop by way of encouragement and helpful cooperation, with the idea in view to get him to like his job and the surroundings that go with it. Get the new man to like his job and the company he is working for, and it is safe to say that he will stay. This does not mean that he should be "coddled" or welcomed with open arms. It means simply the making use of a little everyday common sense on the part of the foreman somewhat along the following lines:

To begin with, have the man's bench and machine ready and clean for him before he comes in. "Tip off" one or two reliable men in the room; tell them that George Brown, a new man, is coming in tomorrow, and ask them to try to make him feel at home.

When the new man comes in, introduce him to at least two or three men who will work near him. In assigning him his first job, give him all the information necessary and make him feel at ease. Don't try to "rush him" at the start by telling him that these machines are promised for such and such a date. Don't keep following him up to see how he is making out. A foreman who knows his job can get a line on a new man without following him up. Every new man, if he is any good at all, will try to make a "showing." Leave him alone and give him a chance to make good. A short social chat with the new man just before quitting time often goes a great way toward helping him to feel at ease and relieving him of his worry—if he has any—about making good.

A good way to get the new man interested in his job is to take him to the assembling room on his second day and show him the assembled machine for which he is making parts. Explain what the machine does and what the parts he is making have to do with the proper functioning of the machine. This will give him a better understanding of his job, and increase his interest and enthusiasm.

CHARLES DOESCHER

THE PROBLEM OF THE SMALL SHOP

The article relating to the problems of the small shop on page 28 of September MACHINERY is very timely. However, the problems referred to are not encountered exclusively in small machine shops, but exist in practically all machine and tool shops. The machine tool and small tool industries have never had a margin of profit (except during the war) that has made it possible for them to pay wages and salaries to their engineers and workers comparable, for example, with those paid in the automobile industry or in non-machine-building fields where skilled men are employed.

It is out of all reason that plumbing work, for example, should be charged for at the rate of from $2 to $2.50 per man-hour, while machine shop work is frequently charged for at $1.25 per hour. The investment in equipment in a machine shop is so much greater than the equipment required for plumbing or carpentry work that there is no possibility of a direct comparison.

What we need is recognition on the part of owners of small and large machine shops alike, building machine tool, small tool and other shop equipment, as well as job shops, that the price charged must be high enough to pay as good wages in this as in other fields; otherwise, we cannot retain a high class of men in the ranks of machinists and toolmakers. After such wages have been paid, there must be enough left for some compensation to the owners who are risking their money in enterprises that often prove unprofitable for years in succession. We cannot maintain our supremacy as a machine-building nation if we are not able to keep in this industry a high grade of men as designers, shop executives, toolmakers, and machinists.

E. G.

WASTE IN LABOR TURNOVER

In these days when there is such a war on waste, the losses due to labor turnover should be carefully considered. The moving about of men from job to job is a very costly thing to those who employ them. Even before the war, when wages were but half of what they are now, one large corporation estimated that the cost of hiring a new man and putting him to work varied from $9 to $65, according to the department in which he was employed. These costs included the clerical cost of hiring, the estimated cost of instructing a new man, the losses in production due to inexperience, and possible damage to machinery and tools. At present, with costs practically double, it would be reasonable to say that the cost of employing a new man is from about $20 to $125, according to the type of employment in the machine shop. When these losses are multiplied by thousands, as in the case of large corporations, the total is enormous.

In a certain period of time, one large company hired over 42,000 men and woman, and out of that number obtained a permanent addition to its force of only 7000. When we consider that similar conditions on a smaller scale are to be found in every manufacturing organization, it is time that we begin to look upon the waste due to constantly changing labor forces as being perhaps fully as important as the waste due to inefficient methods.

V. E.

PLEASANT SURROUNDINGS AS AN INCENTIVE TO GOOD WORK

The writer recently visited a large plant located in a small city, and was much impressed by the attention given to details that would make the shop a pleasant place in which to work. The plant was located away from the crowded part of the city, and was lighted with natural light through large windows. White walls and ceilings added to the natural light and increased the cheerfulness of the shop. The floors were of hard wood and were kept clean, and nowhere was any rubbish to be seen. Surrounding the building was a large grass plot with trees, shrubbery, and flowers. Is it not likely that workers find it easier to work in a place like this?

The writer believes that more attention should be paid to the environment in our shops. There is an inspiration to do better work when surrounded by conditions that make for cheerfulness and health.

WARFIELD WEBB

DRAFTING-BOARD VERSUS WORK-BENCH DESIGNING

By K. H. CRUMRINE, Engineer, Cincinnati Shaper Co., Cincinnati, Ohio

The writer was very much interested in the discussion by Frank H. Mayoh, on page 946 of the August MACHINERY, on the subject of drafting-board versus work-bench designing of jigs, fixtures, and tools.

Theoretically, and assuming that the man on the drawing-board has the experience and ability to design tools as well as or better than the man in the shop, Mr. Mayoh is undoubtedly right. However, it would seem that this is a question that can never be definitely settled for all, as it is a matter governed so largely by local conditions that each concern must decide for themselves which is best, basing their conclusions on the ability of the men available both at the drawing-board and in the shop. One method may be best for one and the other for another, and again both methods might be used, and as a matter of fact are being used, in many cases to advantage, by the same concern.

Let us imagine, for example, a man who has equal ability as a draftsman and as a toolmaker. It is probable that such a man can more consistently design good tools at the drafting-board than at the work-bench. It is also probable, however, that should this same man take his own drawings and go into the shop and actually make the tools, he would make changes and improvements in them that he never thought of when he made the designs, and these not only with respect to technique, but also, in some cases, even as regards the application itself.

The draftsman usually designs a jig or fixture about the drawing of a part drawn up as it is supposed to be, but in many cases not as it is actually found to be, and often a slight difference in the shape of the material from which a part is to be made, or in the condition in which it comes to an operation, necessitates a decided change in the equipment to be used in performing that operation. Also, in many cases, draftsmen who have been away from actual shop experience for a long time, or who have actually had very little, if any, such experience, are inclined to be theoretical rather than practical, with the result that they design tools that are much too complicated and, therefore, less effective and economical than they might be.

On the other hand, the man in the shop, if he is capable at all, is nothing if not practical, and is inclined to make his tools as simply as possible. It is true that this tendency toward simplicity is sometimes due to his desire to complete the job in good time, and often he is limited in his choice to the simplest materials, but it is nevertheless a fact that these simple devices not only usually cost less but are often more effective and economical than the more complicated ones emanating from the drawing-board.

There is many an able toolmaker, although we will grant that the number is not so great as it has been in times gone by, who is skilled in his craft and fully capable of designing jigs and fixtures, but who has never made any study of drafting as it is commonly performed and who cannot turn out a presentable drawing for use by anyone else. Such a man, if we are to have the benefit of his experience and ability along such lines, must necessarily do his designing at the work-bench.

It is true that the designing must actually be done by someone, and we can assume that, if done by the man in the shop, it is not done by him on a drawing-board, but through a process of thinking and imagination, and usually a few rough sketches. Now the process of designing a jig or fixture in the shop is not one in which "Bill," the toolmaker, just out of a job, walks up to his foreman who says, "Bill, I want you to design and make for me a jig for drilling so and so," and Bill answers, "All right boss, I'll go back to my bench and design one and let you know in a day or two what material I'll need."

Instead, it usually happens something like this. The foreman, let us say, of the drilling department, has been drilling a certain part without a jig. In his desire to cut costs and make a showing, he sees that if he had a jig he could save some time and money, and he also sees (and this is important) just how such a jig could be made from a couple of pieces of "cold rolled," four pieces of 1/2-inch drill rod, two jig bushings, and some screws to hold it together. He knows that if his need for a jig gets on the drafting department waiting list he may get a nice jig *some day*, but he doesn't know when, and he also has serious doubts that it will be just what he wants when he does get it.

So he goes over to Bill, the toolmaker, and he says, "Now, Bill, if you can find some time I wish you'd make me a jig for drilling the 1/2-inch holes in those 'B 42 caps,' and I want you to make it like this"—explaining what he wants and handing Bill a rough sketch. Bill, being a practical man, gets the idea at once, and in a few days the foreman begins to turn out profits as well as chips with his new jig which, he says, "may not look so good but sure does the business."

Or, perhaps Mr. Foreman hasn't the ability to see just how the jig could be made or to make an understandable sketch, but can only tell Bill what he wants. In this case, Bill says, "All right, I'll try to figure out something for you," and goes back to his work. Now, when he gets a cut going, or maybe over his pipe after supper, he gets to figuring on what he can make, and presently has something that will turn the trick.

The whole thing boils down to this—that whether designed in the shop or on the drawing-board, someone has to do some thinking first, and the proposition is usually pretty well worked out, with something in the way of drawings or sketches, before any work is actually done in the shop. It would, of course, be absurd and impractical to attempt to make elaborate fixtures without suitable drawings worked out in the usual way on the drawing-board, but even these, when they fall into the hands of Bill, the toolmaker, are often changed and many times improved when unusual conditions are met, of which the draftsman has no knowledge.

* * *

GIVE COMPLETE ADDRESS ON LETTER HEADS

The Post Office Department has requested manufacturers to aid in the campaign for having mail plainly, completely and correctly addressed. This work can be materially aided if manufacturers will always include on their letter and bill heads and other stationary, order blanks, and envelopes, and also in all advertisements, their complete street address. A false sense of pride sometimes induces manufacturers to leave out their address on letter heads, the idea apparently being that the firm is so large and so well known that no street address is required. The Post Office advises that this idea is erroneous. Mail can always be more expeditiously distributed by street and number than when only the name of the firm is used, the address of which must be known to every postal clerk if there is to be no delay. The use of names of buildings in addresses is also objectionable, and the Post Office Department requests that streets and numbers be used instead. The number of office buildings is increasing so rapidly that the use of building names exclusively in addressing mail is a frequent cause of delay in delivery.

* * *

NEW AUTOMOTIVE STANDARDS ADOPTED

Twenty-six revised or new standards relating to aircraft, automobiles, motor coaches, motor boats, and farm tractors, have been adopted by letter ballot of the Society of Automotive Engineers, following approval of the new standards at the summer meeting of the society last June. These have now been incorporated in the data sheets of the society. They cover, among other items, an aeronautical safety code, a farm tractor rating code and tractor testing forms, motor coach specifications and nomenclature, specifications for motor boat engine bed timbers, specifications for molybdenum steels, and storage battery ratings.

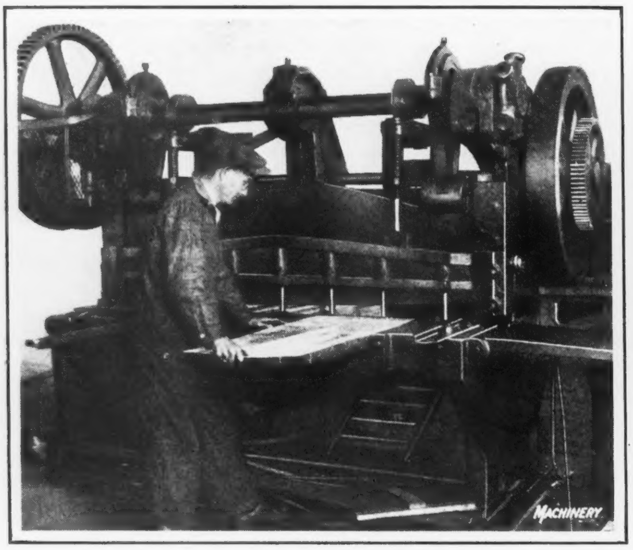


Fig. 1. Shearing Sheet Metal to Correct Size for forming Cartridge Tank

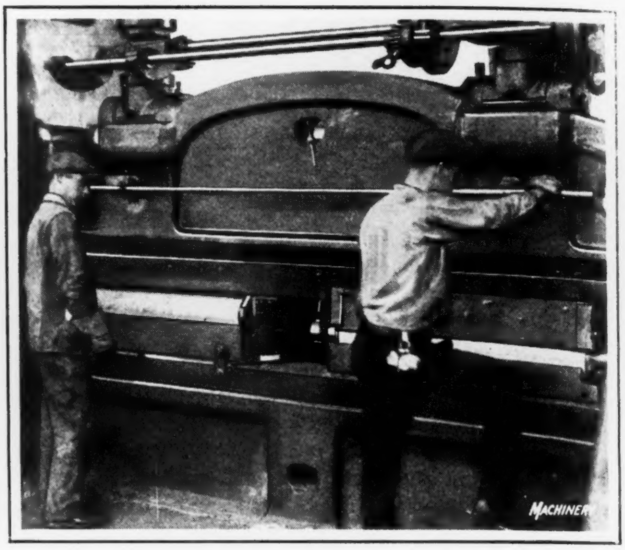


Fig. 2. Forming Cartridge Tank Cylinders on Press equipped with Two Forming Dies

Manufacturing Cartridge Tanks

By R. S. MORECOCK, Master Sheet Metal Worker, Navy Yard, Norfolk, Va.

THE manufacture of cartridge tanks of the type shown at *C*, Fig. 5, was started by the Navy Yard at Norfolk, Va., in September, 1924. Since that date improved methods of handling the work have been adopted, which have brought the present daily production up to 400 complete tanks. These tanks have safety covers, and are used for carrying ammunition which must be kept in air- and water-tight containers.

The tank is made of light-weight galvanized sheet metal, reinforced with pressed steel parts. It is cylindrical in shape, 6.045 inches in diameter, 47.44 inches long over all, with an expanded ring at the bottom and a brass body casting *B* at the top. The bottom ring, shown in Fig. 13, and at *E*, Fig. 7, is known as a stowage ring, and is of the same diameter as the part of the top casting which fits inside the tank body. Each tank has an inner cylinder and rest-block which support the nose of the shell. At the top of the tank there is a cover, which is both water- and air-tight; the cover is held in place by a safety cap and hold-down clamps.

The dimensions of the galvanized sheet-steel stock for the body, as received in the shop, are multiples of the dimensions of the body. The sheet-steel stock is unloaded from the cars at a point near the machine shown in Fig. 1, on which it is sheared to the exact size. This machine is provided with suitable locating stops for gaging the length and width of the sheets for the cartridge tank bodies. By having both length and width gages on the machine, only one handling of the stock is required in cutting a piece to the right size.

Operations on the Tank Body

In front of the shear shown in Fig. 1, there is a gap shear fitted with special notching dies. This machine notches both ends of the sheet at the same time. After this operation, the sheet is lock-seamed and formed to a cylindrical shape. This is done in two operations on the machine shown in Fig. 2. Two workmen are required to operate this machine, which completes the forming of one tank at each stroke.

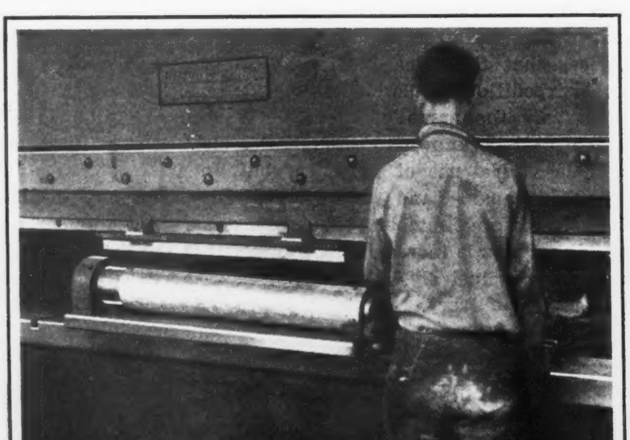


Fig. 3. Lock-seaming Operation on Tank Cylinders

Fig. 4. Assembling Inner Cylinder and Support Block

The sheet steel is shown in Fig. 5 as it appears after each successive operation.

The tank is formed more nearly to an accurate cylindrical shape in the press shown in Fig. 2 than it could ordinarily be formed by rolling. Accuracy in this respect is necessary, because the diameter of the tank must be held within very close limits. The lock-seaming is done on a special mandrel and die fitted in the forming brake shown in Fig. 3. As this mandrel is machined to the exact inside diameter of the tank, the work is made perfectly round and formed to the exact diameter required by the lock-seaming operation.

Fig. 5. Successive Operations in producing Cartridge Tank

After being lock-seamed, the tank is put on a special runway conveyor which leads to the beading machine. A 1/4-inch bead *A*, Fig. 5, is formed around the top end of the tank 2 1/4 inches from the end. This bead serves as a stop for the brass body casting *B*. When this operation is completed, the tank is put on another runway conveyor, which takes it to the flanging machine, where the edges of both ends are flanged and an offset of 1/8 inch is formed. The offset is necessary in order to bring the bottom flush with the outside. At the completion of this operation the body is ready to be assembled.

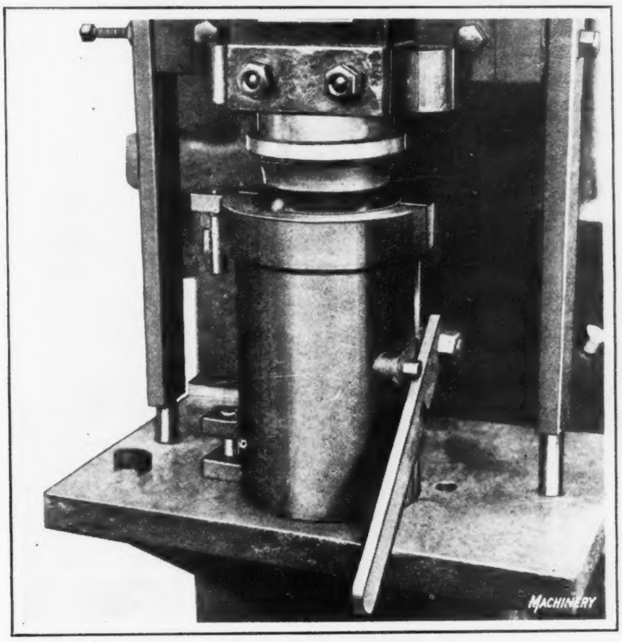


Fig. 6. Press equipped for Flanging Operation on Inner Cylinders

Making the Inner Cylinder and Support Block

The inner cylinder and support block shown in Fig. 4 are the members that hold and support the cartridge. The inner cylinder *C* is 5 inches in diameter and 12.625 inches long. This part is made of steel, has a spot-welded seam, and is flanged or formed to a bell-mouth shape at the top end. The diameter of this cylinder is required to be held to very close limits. It is fitted over a gum wood block *D*, and secured to it by four wood screws.

On the top end of the wooden block, inside the shell cylinder, there is a steel washer, 1/4 inch thick, with an outside diameter of 6 inches and an inside diameter of 3.75 inches. This ring is secured to the wooden block with nails. The wooden block is made from a single piece of gum wood, and is turned in a lathe, after which it is saturated with hot linseed oil in order to keep it from shrinking or getting out of shape.

The job of manufacturing the inner cylinders in quantities, with a tolerance on the inside diameter of 0.005 inch, requires considerable care. The material is first sheared to the required length and width. Then the sheets are punched for screw-holes, after which they are formed into cylinders of the required diameter and spot-welded. The seam is next offset to bring the walls of the cylinder to a true cylindrical shape on the inside, after which the flange is formed at one end by the special die shown in Fig. 6. This die makes the shell bell-mouthed at the top end as shown. After all parts are assembled on the inner cylinder, it is sent to the final assembling department to be installed in a finished tank.

The stowage ring shown in Fig. 13 is a small piece, but it plays an important part in the final assembly of the tank. It is a cup-shaped pressed-steel part drawn in at the top end, which is open. The first operation after shearing is to draw it into a cup, as shown at *A*, Fig. 7, in a double-acting drawing press. This cup is 7.4 inches in diameter, 2.375 inches deep, and is drawn from No. 13 gage steel.

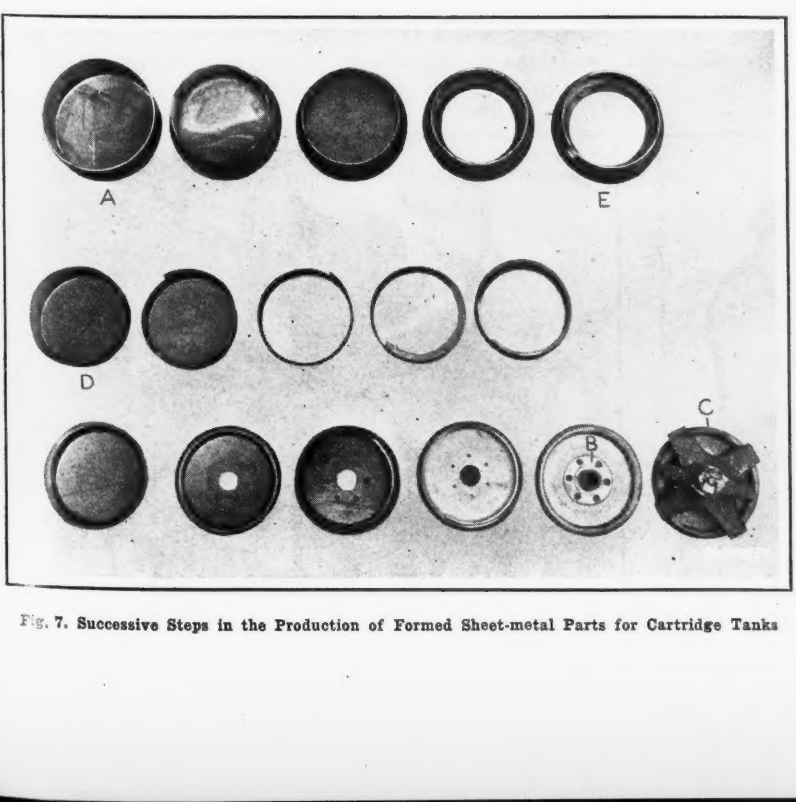


Fig. 7. Successive Steps in the Production of Formed Sheet-metal Parts for Cartridge Tanks

After being drawn to shape, the cup is heated in a special water-jacketed furnace fire, and while still hot is spun to a diameter of 6.13 inches for a depth of 1 1/4 inches. This operation is performed in a lathe, using a straight die or mandrel, which permits the operation to be performed much more quickly than if a collapsing mandrel were used. After the spinning operation, the ring is trimmed to a height of 2.25 inches, employing a special jig fitted to a rotary shear. The final operation on this part is notching the edge so that it will fit under the grooved lock-seam of the tank. The appearance of the stowage ring after each of the operations is shown by the views to the right of view *A*, Fig. 7.

Fig. 8. Notching and flanging the Cover shown at A, Fig. 14

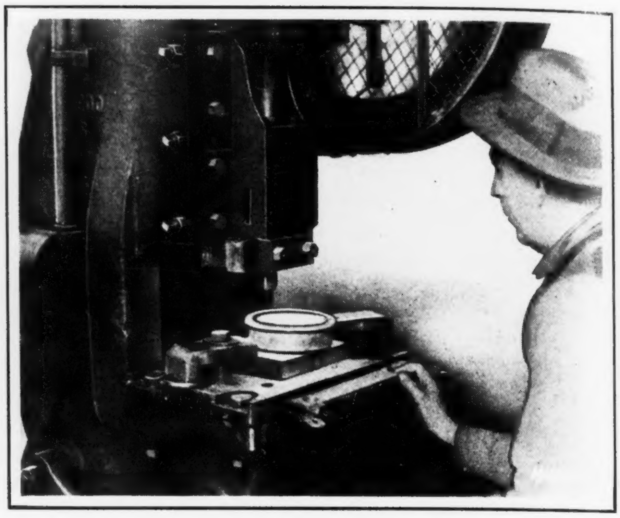


Fig. 9. Stamping Plan and Piece Numbers on Parts before assembling

Making the Tank Covers

The cover for the tank is a most important part in that it must be both air- and water-tight. It consists of two main parts of pressed sheet steel, one of which is the cover proper, shown at *A*, Fig. 14, and the other the extractor shown at *B*. The cover proper is made of No. 16 gage sheet steel, pressed into a pan shape, with a recess around the edge for a rubber gasket. This part is made in three operations, namely, blanking, drawing, and punching and curling. The appearance of the work after each of these operations is shown in the lower row of views in Fig. 7.

The extractor is made of No. 20 gage sheet steel, which is first formed to the cup shape shown at *D*, Fig. 7. The diameter of this cup is 5.75 inches at the bottom, with the top offset or enlarged to a diameter of 6.03 inches, as shown at *B*, Fig. 14. The appearance of the cover after each successive operation is shown by the views at the right of view *D*, Fig. 7. The cover is notched and flanged in one operation on a special die. After this operation, the flange is trimmed to the required diameter and the bottom punched out on the press shown in Fig. 8.

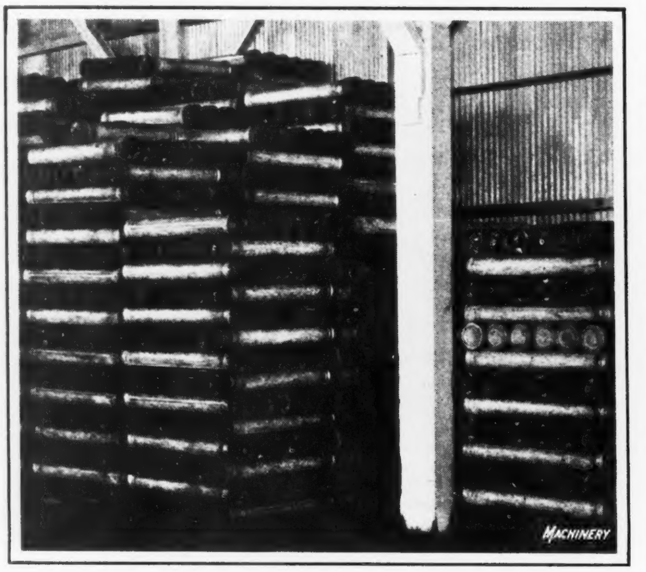


Fig. 10. Finished Cartridge Tanks stacked up in Store-room

The cover and the extractor are next assembled and joined by spot-welding. The function of the extractor is to remove the cartridge from the tank, the flanged end being so formed that it hooks over the bottom end or flange of the cartridge. After the cover is spot-welded to the extractor and galvanized, the brass stud casting shown at *B*, Fig. 7, is riveted and sweated to the top cover. The stud casting is fitted with a clamping screw and safety plug cap. On the inside of this stud there is a spindle having a wax packing and clamping nut, and there is a rubber gasket around the outer edge of the cover. The wax packing makes the cap plug air- and water-tight, and the rubber gasket around the edge makes a tight joint between the tank and the cover. Each piece that goes into the tank is stencilled or stamped with the plan and piece number, and as each part is completed it is shipped to the assembling department. Fig. 9 shows the press used in stamping the covers.

Assembling Operations

After the sheet metal which forms the body is edged and offset, it is taken to a spinning lathe, where the bottom is

Fig. 11. Seaming on the Bottom of a Cartridge Tank

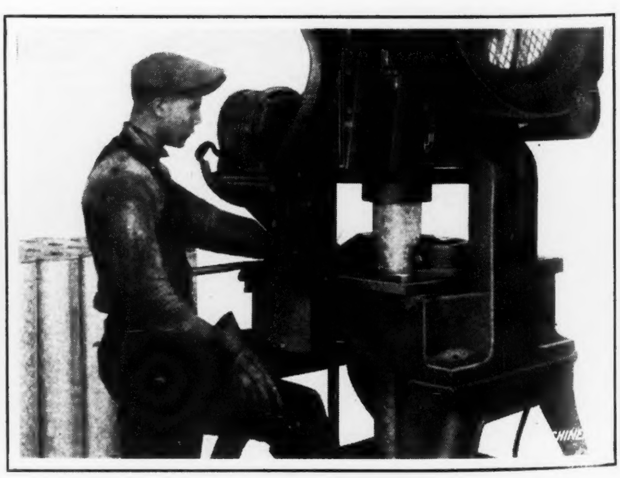


Fig. 12. Assembling Brass Body on Cartridge Tank

seamed on. The bottom is a simple pan-shaped part, 3/16 inch deep and 6 inches in diameter, with a 1/4-inch bead 5 inches in diameter. The lathe in which this operation is performed is shown in Fig. 11. The next operation is to put the brass body casting on the tank and lock the edge of the tank over the casting. This is done on the special locking die shown in Fig. 12. Following this assembling operation, the tank is transported to the soldering department, and from there it goes to the testing and final assembly department.

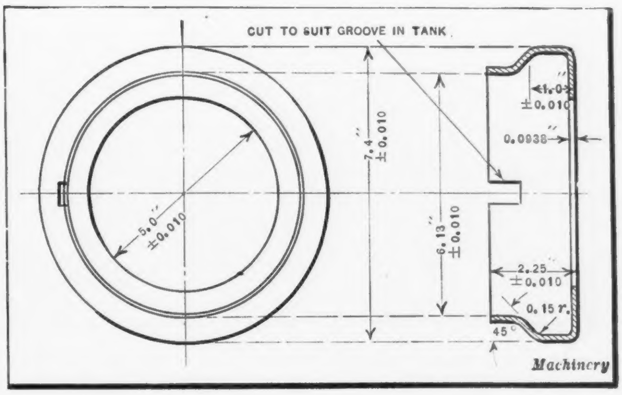


Fig. 13. Details of Cartridge Tank Stowage Ring

Before any castings are assembled on the tanks or covers, they are tinned on the side that comes in contact with the other surfaces in order to obtain thoroughly sweated joints. In the soldering department, the tanks are first expanded to their proper diameter on a special expander fitted to an engine lathe. They are then soldered around the bottom by dipping in hot solder. This dipping operation sweats the solder into the seam and makes a tight strong joint. The tank is sweated around the brass body casting at the top by an oil torch. Solder is also sweated into the entire 2-inch space between the steel ring and the brass casting, thus making a tight and rigid joint at this point. After the stowage ring is fitted on the bottom and sweated on, the tank is tested for leaks with an internal pressure of 5 pounds. The inner cylinder is then pressed into the tank by the use of a special fixture. The cover goes to the final assembly department completely assembled with clamping screws, gaskets, and all parts, as shown at *C*, Fig. 7.

* * *

EARLY FILES AND FILING METHODS

In making a study of the history of files and filing, the Simonds Saw & Steel Co., Fitchburg, Mass., has collected some interesting data on this subject. The history of the file goes back to the prehistoric age. The earliest files to which reference can be found appear to have been made from the skins of certain fish, and even today in Great Britain old-fashioned wood carvers use the skins of the dog fish to smooth their work. Files made from bronze were in use when this metal was the general material for tools and implements, and there is evidence in the Bible that different shapes of files were in use about three thousand years ago.

Steel files have been used for several centuries, and in an eighteenth century French encyclopedia there are a number of illustrations of files which differ in few respects from the modern tool. It is not long ago that all files were cut by hand, but at present more than 90 per cent of the files are machine-cut. Although the machine-cutting of files is a comparatively recent development, the idea of machine-cutting is by no means new. Raoul, a Frenchman, cut files by machinery in the eighteenth century, and in 1836 a file-cutting machine patented by Captain John Ericsson was used in England. Today machine-cut files are made with as many as 180 teeth to the inch, the cuts being scarcely discernible to the eye.

* * *

There is a great deal of misunderstanding as to what really constitutes good light. Bright light is by no means good light. Bright sunlight, for example, is a very objectionable light for most classes of work. Any light may be good—whether it be sunlight, gaslight, or electric light—provided there is enough of it, and provided it is steady, and properly shaded or diffused. No light is good—whether natural or artificial—if it flickers or is unsteady, if it is insufficient or of too great intensity, if the source is unshaded, or if it produces a glare.

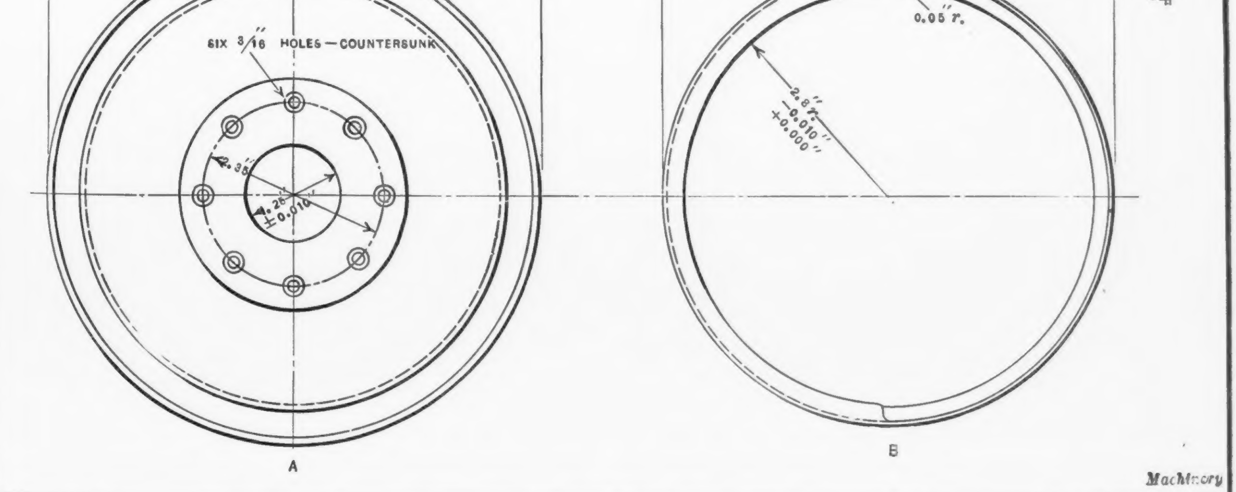


Fig. 14. Cover and Extractor used on Cartridge Tank

Scientific Management—Applied Common Sense

By J. SETON GRAY

DURING the last ten or fifteen years there has been a great deal of discussion of the merits of scientific management. To the average mechanic, the words "scientific management" mean very little and are likely, when mentioned, to create an antagonistic attitude. If he has only a public school education, he feels that anything that is scientific is beyond his comprehension. Perhaps he had to start to work when he was fourteen years old and has had no further educational opportunities. He immediately concludes that it is impossible for him to grasp even the fundamentals of this new system which he frequently hears mentioned and which he knows is introduced in many factories. As a result, he is immediately on the defensive, even before he has seen how the system works and how it would affect him and the factory in which he is working.

There is a great deal more in a name than those who have sponsored scientific management appreciate. To make any system of management successful in a plant, it is not sufficient that the board of directors, the works manager, and the general superintendent be in favor of it. They may understand the advantages of its introduction and how it would remedy wrong conditions and eliminate waste; but if the men in the factory are "against it," even before they know the first principles that are involved, the introduction of the system will prove very difficult, and it will not be so successful as if it could have been explained simply to the men from the very start and their confidence thus gained.

The Elementary Principle of Management is Common Sense

Scientific management can be simply explained; it is not a deep mystery. It is based on simple, general principles, the main one of which is common sense. If good common sense has been used in the operation of a factory, any man endeavoring to introduce some scheme labeled scientific management will find great difficulty in justifying his presence. Applied common sense in factory management is really scientific management. If a factory organization were told that common sense principles were to be applied to the running of the factory, there would be no opposition. On the contrary, most men would be glad to render assistance, because there is nothing on which the average man prides himself more than that he has good common sense. Also, every man feels that if common sense is applied to the management of the department in which he is working, the results will become apparent in improved conditions which will benefit him.

Time and motion studies have been associated with scientific management from the beginning. There is no reason, however, why such studies should be opposed by the men if their purpose is carefully explained and no secrecy maintained in regard to the methods employed. It is only common sense that the management of a factory should wish to know the actual conditions that exist, make an intelligent study of them, and avoid guesswork. Most men will admit that, and most shop men are reasonable when properly approached. The main reason why men oppose new methods is fear—fear that the new methods are to make their struggle for existence more difficult. If they understand that the purpose is to help them as well as the firm, rather than the contrary, there will be no opposition.

Establishing Piece-work Rates by Guesswork

In the past, piece-work rates were generally set by snap judgment by the foreman of a department. Sometimes experience and judgment enabled him to guess quite accurately, but more often the guess would not compare favorably with the results of a careful time study. The usual procedure, if the guess was wrong and the man made too much money, was to cut the rate. If after this cut the man still continued to make more than was considered average good pay, there was another cut, with the result that the men learned just how far they could go in producing without the danger of having the rate cut. They went to that point and no further. Such haphazard methods of setting piece-rates create a lack of confidence, and the best production results can never be obtained under these circumstances.

Common sense teaches that when a piece-rate is once established it should remain fixed for a considerable period, or until some change is made in the shop equipment or methods which enables greater production because of additional investment on the part of the firm. If piece-rates are constantly changed, it is impossible to maintain the confidence of the employes. Time studies make it possible for the management to gain an accurate knowledge of the work to be done, so that fair piece-rates can be set and maintained.

Foremen Must Have the Confidence of the Firm

If a foreman is to run a department efficiently, he must have some information relating to costs—not only labor costs, but general costs entering into the manufacturing business. In one factory, the general superintendent's attention was called to the fact that electric bulbs costing over $800 a month were bought for the plant. A notice was issued to all department heads calling their attention to this expenditure and listing the number and cost of the bulbs issued to each department. It became obvious that carelessness had been responsible for breakage of a great number of bulbs, because as soon as the condition had been called to the attention of those in charge, the electric light bulb cost was reduced to $150 the following month, and for a period of two years after the issuing of the notice, the average cost per month ran to slightly over $100.

How Time Studies Aid in Obtaining Results

Every manager knows that there is a certain amount of "soldiering" going on in the factory. It is for the foremen to prevent this, but it can be done only where the manager and the foremen have some knowledge of what constitutes a fair rate of effort, and this, in turn, can only be determined by intelligent time study.

It is only common sense to use past performances as a guide in forming an idea of what can be done in the future. A man must have something to shoot at, as, for example, the previous best record established in a particular department. Also, it is only human nature that he will try to beat that record. When a manager succeeds in creating a desire in his foremen and employes to better past performance, the spirit of the game enters into the work, and the men can be made to look upon their work as a game rather than as a task. Previous performances are almost certain to be eclipsed.

Instruction of Foremen is an Important Duty of the Management

The best efficiency engineers a plant can have are the departmental foremen, provided they understand their duties and realize how their own departments are linked with all other departments. The factory manager who applies common sense in management will make plain to every foreman

what is expected of him, and will check up from time to time to see that the various departments function properly. The foremen are the backbone of any organization.

Management, whether you call it scientific or common sense, remains what it always has been, the directing of the activities of others. Good management so directs these activities that the best results are obtained with the least amount of effort—human or mechanical. Systems are necessary, but they should be flexible. Systems that are contrary to the ideas and methods of the foremen or others responsible for results will create dissension and will not produce the results expected. If the systems really seem necessary for good results and they are opposed by the foremen, then it is necessary to educate the foremen so that they will be able to see the value of the system proposed. Forcing systems and methods on others does not work. Men must be educated to accept the methods as superior.

The Importance of the Outside View

While the opinions and ideas of the organization must not be too lightly passed over, all the advice and assistance that can be obtained from the outside should be made use of. An outsider will see many errors that inside men do not see. When a report is brought in it should be made known to everyone that will be affected by any changes to be made. The facts should be presented to the foremen and the men in understandable form. If the remedies can be applied by the foremen and men themselves, leave them alone to remedy conditions in accordance with the suggestions made. It may take a while longer to obtain results in that manner, but no dissatisfaction will be created, and if the men in the plant feel that they are responsible for the improvement, they will go further than an outsider could. Also, when the outside expert leaves the factory there is a general tendency to drift back to the old conditions, but if the results have been obtained through the organization itself, the management will have no difficulty in maintaining these results. A check-up from time to time must take place, however, to see that a continued effort is maintained.

As an example of what may be accomplished through common sense efficiency methods, may be mentioned the case of a certain factory engaged in manufacturing rifle grenades during the war, which had great difficulty in obtaining the desired production. The factory had been built to produce 100,000 grenades per day, and yet it was found difficult to obtain an output of even 60 per cent of this. All the foremen were brought together in a conference, and the situation explained to them. They were asked to cooperate with one another with a view to producing the required shipments, and each was made to understand that his value was measured by the total results of the entire plant. The operations in the different departments were synchronized so that the number of parts required to complete a certain number of grenades was produced in each department—that amount and no more. The following day 65,000 pieces were produced in every department, and 65,000 grenades were completed. Although the plant had been built to produce only 100,000 per day, the actual production was 165,000 per day at the end of the war when operations were suspended. This was done with the same organization, the same plant, and practically the same equipment, the production per man per hour being brought up from 12 to 29.

Saving Tool Expense by Cooperative Effort

In a plant where there is a great deal of pressed-steel work done, the cost of production tools, such as drills and reamers, amounted to 36 cents per unit. The attention of the foremen was called to this cost, and it was gradually reduced to 12.5 cents per unit. Over a period of two years it never rose over 15 cents per unit. In the same factory, the production per man hour was gradually increased from 26 to 36.5 units, the latter figure being an average for an entire year. Supplies that used to cost \$1.60 per unit cost less than \$1 per unit for over a year. The value of scrap used to run up to \$2.60 per unit. This waste has gradually been brought down so that it averaged, for an entire year, 60 cents per unit. In one particular department, the production per man was increased 125 per cent.

All these savings were accomplished simply by presenting operating facts and figures to the foremen and gang bosses in understandable form.

Reducing Cost by Increasing Production

A factory making parts for automobiles found that in order to get certain contracts, it would be necessary to take the work at a much lower figure than formerly. The general superintendent called all the foremen together and told them the circumstances, the management having taken the contract to keep the factory running, and they were told that the price would permit the company to just about break even. But it was believed that the factory organization could do better than they had in the past, and it was up to the foremen to find ways and means to reduce manufacturing costs if they wished the company, and consequently themselves, to be successful. Inside of forty-five days the productive labor cost had been reduced 15.5 per cent. In not one instance was this saving accomplished by a cut in the piece-rates or wages of the men but in every case was brought about by improved methods of doing the work.

The Question of Equipment

Foremen, as a general rule, welcome new machinery and equipment in their department. A good foreman, however, will check up on the equipment already available, to make sure whether satisfactory work could not be performed on the existing equipment if properly handled. A great deal of money is tied up in over-equipping plants and increasing costs in this manner. When new equipment can produce cheaper than old equipment and the investment in new equipment can be repaid within a reasonable time, it should be bought by all means; but a real investigation into costs should always be made. Sometimes it is found that by providing additional tooling the existing equipment is ample for the increased output required. Unless the equipment is reasonably well employed, because the output demands that it runs most of the time, decreased production time may not mean decreased costs, because the overhead charges due to the investment in the new equipment may consume the profits.

Obtaining the Cooperation of the Worker

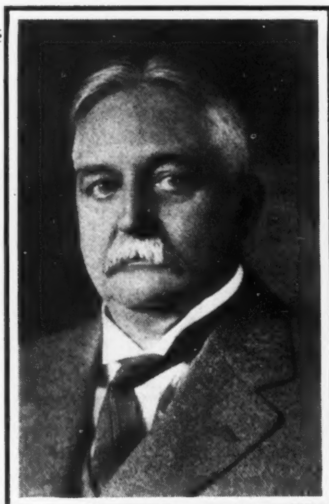
Common-sense management takes advantage of the curiosity of the worker by presenting the possibilities of his job to him in such a way that he will be anxious to demonstrate to his own satisfaction whether or not there is any foundation for the claims made for given tools or methods. If production is increased he will, of course, also expect it to have some effect on his own earnings.

Too many things are decided by the judgment of someone who may have had particular experience along certain lines, but whose decision, nevertheless, is merely a good guess. Common sense teaches us that the only way in which to decide anything right is to base the decision upon facts and figures, so that there will be no question about the accuracy of the decision.

Furthermore, when changes of any kind are to be made in a factory, it is a good policy to go slow. It has taken years to develop the present methods of doing work. They are reasonably successful and they should not be changed over night. Do not throw out a system that works well at present because it is old, and install another immediately. Rather begin with a few changes and let these be digested before going any further. Let the new methods gradually supersede the old. Nothing worth while was ever accomplished in a hurry. The average man or the average organization does not like changes, and the only way to make the changes effective is to introduce them gradually so as to avoid opposition. Then it is easy to take the next step. Remember, further, that there is nothing mysterious about management, no matter what name is applied to it. Its basic quality must be that it is applied common sense.

Graphical Analysis of the Geneva Stop

By C. M. CONRADSON



IN designing a Geneva stop mechanism for intermittently indexing a shaft or some other machine member through part of a revolution, it is frequently difficult for the designer unfamiliar with the mechanism to study its action. The following analysis is presented with a view to making the study of this mechanism easier. In the analysis it will be shown that a pair of imaginary arms connected by an imaginary link can be substituted for the Geneva stop mechanism and be kinematically identical with it. This is true for every point of the working range of the stop motion. The imaginary arms and connecting link will be of varying lengths at the different points of action, but at every point will be subject to the very simple laws covering the action of link work.

Fig. 1 shows in outline a typical form of the Geneva stop at the beginning of the cycle. For simplicity, four slots are shown in the driven wheel *N*, although this analysis is equally applicable to any number of slots. The driving arm is shown at *M*, the center of the driving arm at *A*, the center of the driven wheel at *B*, and the center of the roller at *E*.

Laying out the Imaginary Arms and Link

The same mechanism is illustrated in Fig. 2 at an intermediate point in the cycle; here the letter *O* represents the imaginary driving arm, *P* the imaginary driven arm, and *Q* the imaginary connecting link. The imaginary arms and link are laid out as follows: Draw a line connecting *E*, the center of the roller, and *B*, the center of the driven wheel. Passing through *E*, draw the normal *ED*, and through *A* draw a normal to *ED*, intersecting at *D*. The imaginary driving arm, is now length *AD*, the imaginary driven arm, *EB*, and the imaginary connecting link, *ED*. It is obvious that this imaginary linkage system kinematically replaces the Geneva stop for the point of the cycle at which *E* is in this illustration.

Fig. 3 shows the mechanism laid out with center *E* at a point still further advanced in the cycle. It will be noted from this illustration that the imaginary driving arm *O* has lengthened and that the arm *P* and link *Q* have shortened.

In Fig. 5, the mechanism is shown at the middle of the cycle, where the imaginary driving arm attains its maximum length and coincides in length and position with the actual driving arm *M*. The imaginary driven link has shortened to the minimum, coinciding in position and length with line *BE* of the driven wheel, and the length of the connecting link is now zero. At this point the velocity ratio is at the maximum.

At the initial position of the Geneva stop, which is illustrated in Fig. 4, the length of the imaginary driving arm is zero and the length of the driven link equal to *BE*, the maximum acting radius of the driven wheel. The length of the imaginary connecting link is also zero. In this case, the velocity ratio is evidently zero.

Determining the Velocity Ratios at Intermediate Points

It is now in order to show the method of finding the velocity ratio at intermediate points. In Fig. 2, the ratio is, by the law of leverages $\frac{AD}{BE}$, as the connecting link is normal to both levers, and in Fig. 3 the velocity ratio is also $\frac{AD}{BE}$. (Compare with a pair of pulleys of radius *AD* and *BE*, connected by a belt *DE*.) By laying out a number of lever

C. M. CONRADSON was born in a log house in southern Wisconsin in 1861. After finishing high-school, he obtained the degree of mechanical engineer from the University of Wisconsin in 1883. Things mechanical interested him from an early age, and when he was twelve years old, he made a boiler and steam engine that operated satisfactorily. Later he built a bench lathe that would swing 6 1/4 to 15 inches. While at the university he invented and patented a geared windmill which was manufactured for many years, and also designed for the university machine shop a portable boring machine. In 1884, he designed and built a turret lathe, which at that time effected a saving of 80 per cent in labor costs. While employed by the Edward P. Allis Co. in the manufacture of Corliss engines, he developed heavy turret lathes and tooling equipments, which he considers the most important work of his life. Among the many other mechanical developments that have engaged Mr. Conradson's attention are a universal tool grinding machine; electric motors for direct-driving of machine tools; and hydraulically actuated automatic lathes, both of the single-spindle and multi-spindle types, the former being developed in 1891 and patented in 1893, and the latter in 1907. He also has done a great deal toward the introduction of individual motor drives, the largest early individual motor-driven installation of machine tools in the world being at the New York Shipbuilding Co., which example was later followed in many other plants, notably in the Brooklyn Navy Yard.

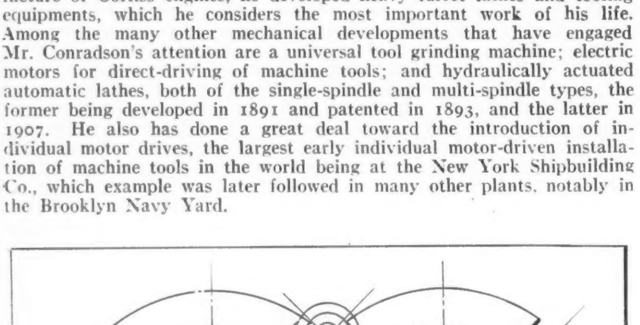


Fig. 1. Outline of a Typical Form of the Geneva Stop at the Beginning of a Cycle

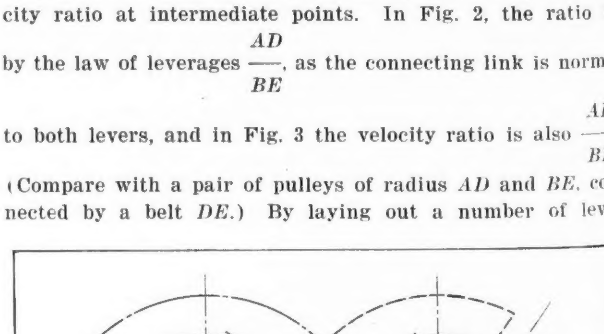


Fig. 2. Geneva Stop, with Imaginary Arms and Link that are kinematically Identical with the Stop

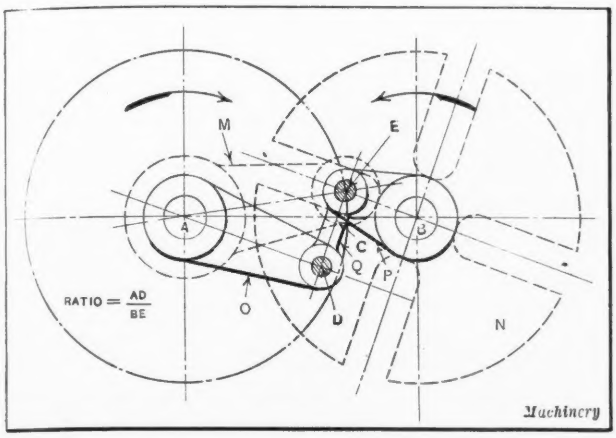


Fig. 3. Illustration showing Geneva Stop Mechanism further advanced along its Cycle

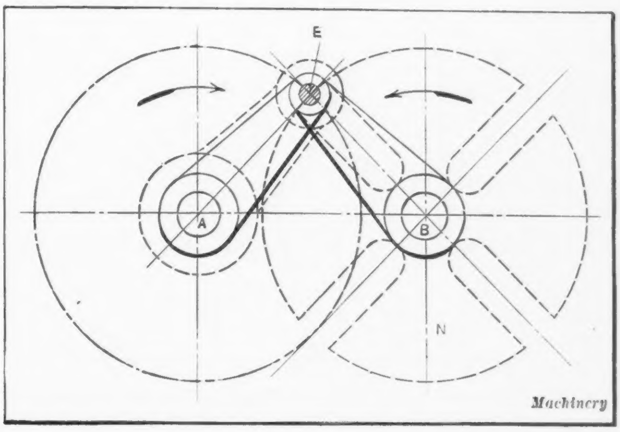


Fig. 4. Initial Position of Geneva Stop, at which Point the Velocity Ratio is Zero

systems, as in Figs. 2 and 3, the velocity curve of a Geneva stop mechanism can be determined for as many points as desired.

There is, however, a more direct method of determining the velocity ratio. In Figs. 2 and 3, the triangles ADC and BEC are similar by construction; therefore $AD : BE :: AC : BC$. Hence $\frac{AD}{BE}$ equals $\frac{AC}{BC}$, and the velocity ratio is equal to $\frac{AC}{BC}$. Lines AC and BC are the segments into which the imaginary connecting link Q divides the line of centers AB.

In Stahl and Woods' "Elementary Mechanism," Chapter II, the law of communication of motion by linkwork is expressed as follows:

"I. The angular velocities of the arms are inversely proportional to the perpendiculars from the fixed centers of motion upon the line of the link.

"II. The angular velocities of the arms are inversely proportional to the segments into which the line of the link divides the line of the centers."

Laying out the Velocity Curve

To lay out the velocity curve, first divide the circumference EE_1, Fig. 7, into any number of parts, preferably equal. Then from B draw lines BX, BY, etc., through these points spaced out on the circumference. From these lines BX, BY, etc., draw normals 40-40, 35-35, etc., intersecting the points on the circumference and the line of centers AB. Now, assuming that A-15 along the line of centers measures 2.4 inches, and B-15, 6 inches, the velocity ratio at point 15 on the circumference equals 2.4 ÷ 6 or 0.4. Compare this result with the velocity curve in Fig. 6.

Now prepare for laying out the velocity curve by erecting ordinates on the base line 0-90, Fig. 6, at equal distances apart. Lay off on each ordinate a distance corresponding to the quotient obtained by dividing $\frac{A\text{-}5}{B\text{-}5}$, $\frac{A\text{-}10}{B\text{-}10}$, etc., and connect these points. The resulting curve will be tangent to the base line at 0 and 90 and tangent to a line parallel to the base at the vertex, as shown.

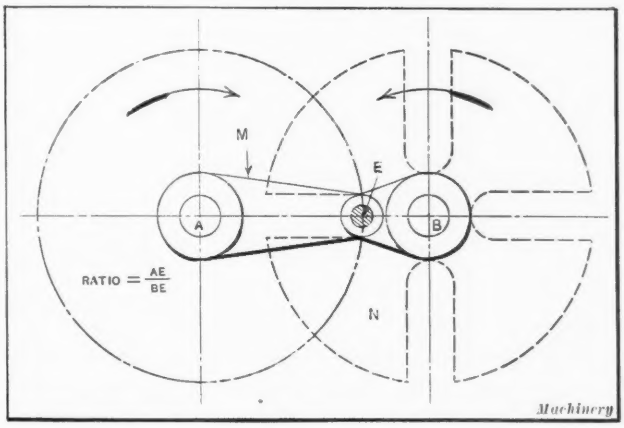


Fig. 5. Mechanism at Middle of Cycle, where Velocity Ratio is at the Maximum

If a slight incursion into the domain of the Calculus will be permitted, it is evident that $\frac{dy}{dx}$, which equals the tangent of the angle of "slope" gradually diminishes and at the vertex becomes zero, showing that the rate of increase of the velocity at the vertex is zero. The velocity, therefore, begins at zero, gradually increases to a maximum at the vertex of the curve, and then gradually diminishes till at the end of the cycle it again becomes zero.

Using the Velocity Curve

If it is desired to find the point at which a velocity of 100 per cent occurs, bisect the line of centers AB, as in Fig. 8. On these segments draw the semicircles ADC and CEB. Through point E where one semicircle intersects the path of the center of the roller, draw the line ED, intersecting the line of centers AB through C. The angle CEB, being drawn on a diameter, will be a right angle. From A drop a normal AD, intersecting DE. The velocity ratio is $AC \div BC$, which equals 1.

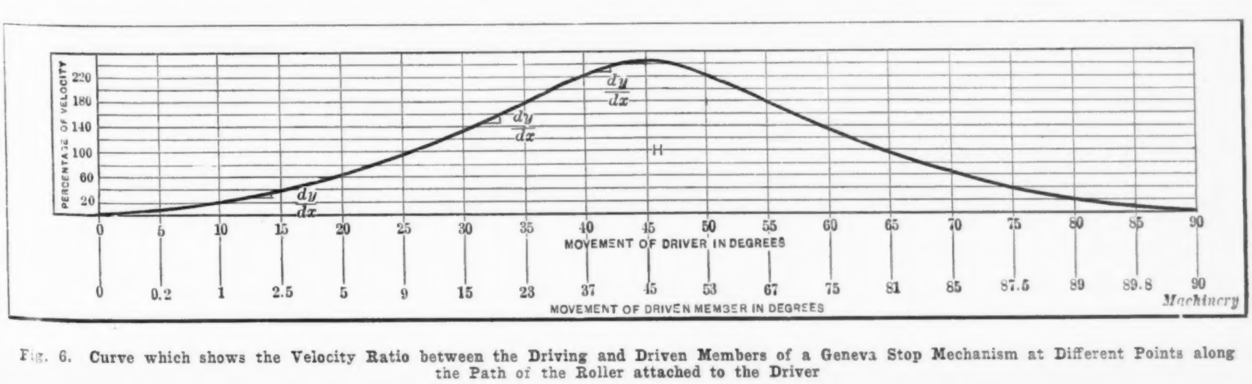


Fig. 6. Curve which shows the Velocity Ratio between the Driving and Driven Members of a Geneva Stop Mechanism at Different Points along the Path of the Roller attached to the Driver

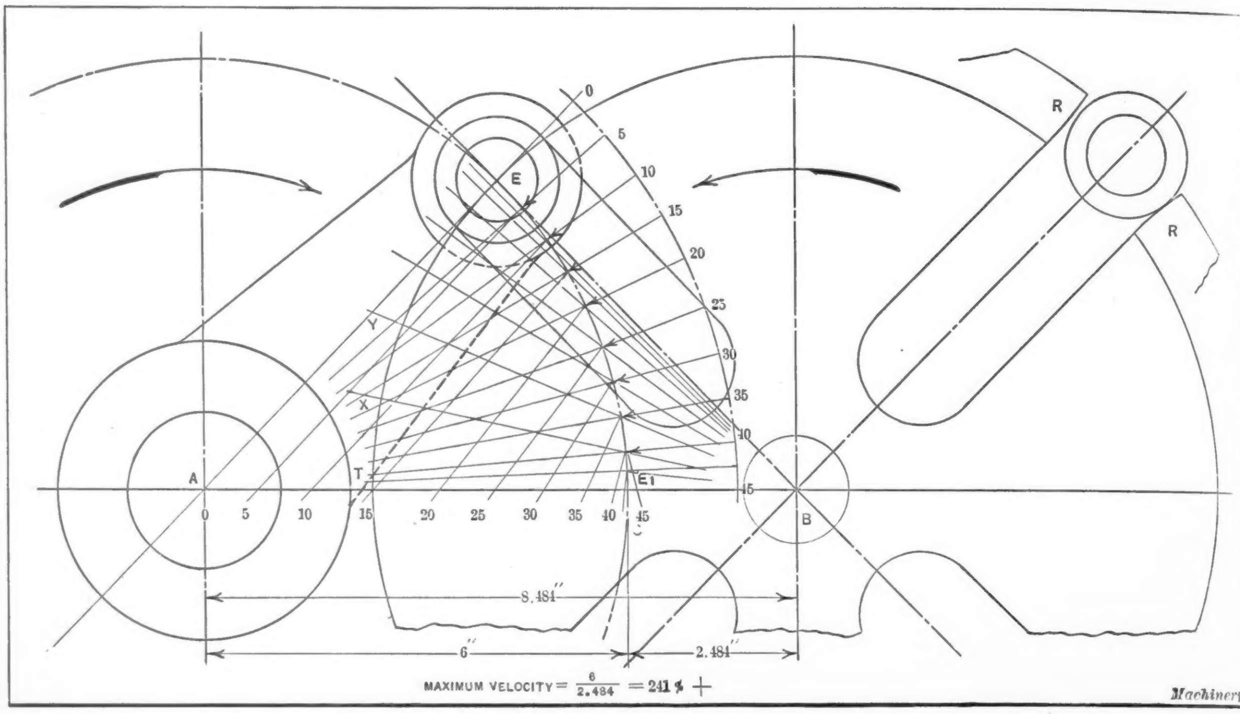


Fig. 7. Procedure followed in graphically determining the Velocity of the Driven Member at Various Points along the Path of the Roller attached to the Driver

The construction for the 200 per cent ratio is shown in Fig. 9; in this case, the line of centers is trisected. Horizontal lines may be drawn intersecting the velocity curve in such a manner as to afford instant means for determining the velocity at any desired point. A ready method is to determine by the means suggested in the preceding paragraph, the height of ordinate *H*-45, Fig. 6, for a 100 per cent increase. Then divide *H*-45 into five equal parts, each of which will be equal to 20 per cent. Draw horizontal lines through these points of division and where these lines intersect the velocity curve, the velocity percentage will be known. The whole range of the velocity curve can be treated in this manner. It will be obvious that the velocity, after the driving member has moved 10 degrees, is found at the intersection of the ordinate 10 and the horizontal line marked 20 per cent.

To find the angular position of the driven wheel, prolong the lines *BX*, *BY*, etc., in Fig. 7, until they intersect arc *ET*. Measure angles *ABX*, *ABY*, etc., and lay off below the velocity curve, as shown in Fig. 6. The angular position of the driven wheel corresponding to any position of the driver can then be read off directly.

The only practical point in the design of the Geneva stop that will be here alluded to is to call attention to the desirability of enlarging the diameter of the driven wheel, as shown at points *R*, Fig. 7. This permits of operating a locking mechanism while the driven wheel is constrained by the driver, and makes the Geneva stop of very general application in automatic and semi-automatic machinery.

* * *

ELECTRIC WELDING IN BUILDING CONSTRUCTION

A building has just been completed in Canton, Ohio, on which no rivets are used on the structural steel work, all joints being electrically welded. The structure is a two-story and basement building, 100 by 150 feet. The designs originally called for riveted construction, but the architects, building inspector, and owner agreed upon the use of the welding process instead. The steel was fabricated by the Morgan Engineering Co., of Alliance, Ohio, and welding was adopted only after this company had made its own tests and was satisfied in regard to the reliability of this method of joining steel members. Lincoln electric arc welding machines were used on this job. It is believed that this is the first complete building construction of its kind in the United States where no rivets have been used.

* * *

A survey of the motor bus transportation field indicates that there are about 60,000 buses operating in the United States at the present time.

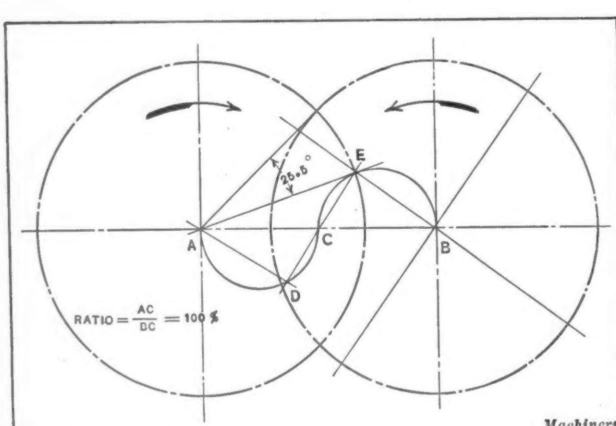


Fig. 8. Method of determining at which Point a Velocity Ratio of 100 Per Cent is obtained in the Movement of the Driving and Driven Members

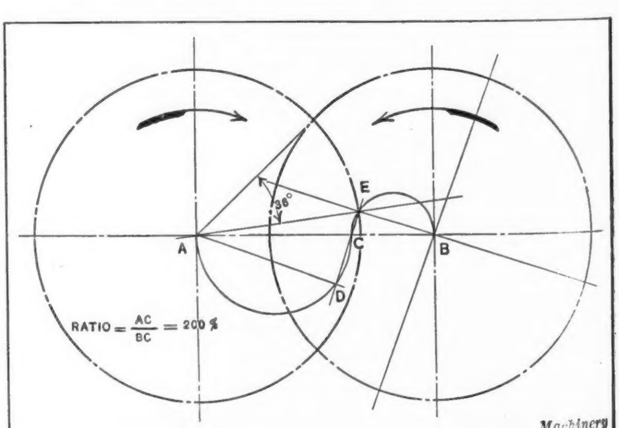


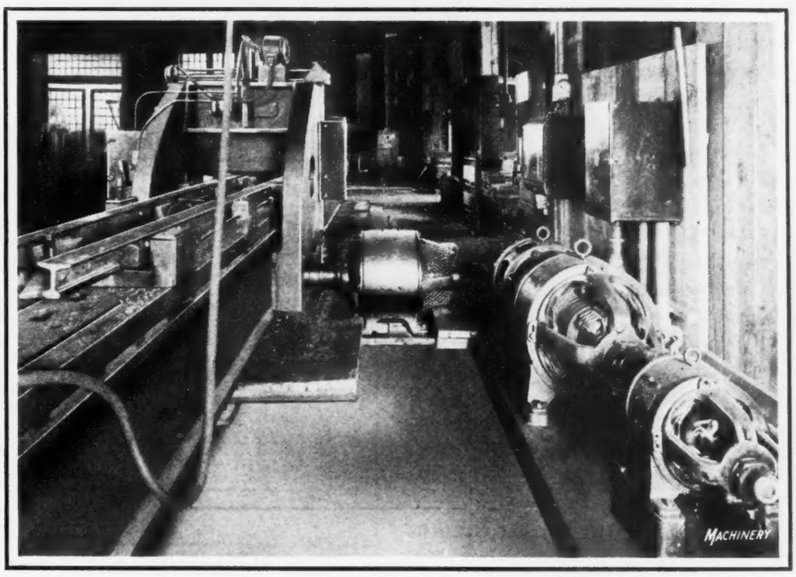
Fig. 9. Construction used to determine at which Point a Velocity Ratio of 200 Per Cent is obtained between the Driving and Driven Members

Variable-voltage Reversing Planer Drive

By A. L. HARVEY, General Engineer, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

THE most common machine tool operation on flat surfaces is planing. Originally, power-driven planers were run by means of open and crossed belts, but about twenty years ago, the direct-current reversing motor drive came into use. This drive has been very successful, and is now used on nearly all planers except those of small size. With it the operator is able to obtain greater output than can be procured from similar machines equipped with belt or other forms of drive. The drawback to this drive, however, is that direct current at a voltage not exceeding 250, is required, and shops not equipped with a power circuit of this character must install motor-generator sets to obtain the benefit of this drive. The motor is of the adjustable-speed direct-current type, having a speed range of 4 to 1, as no other type has been found suitable for this service.

The development of the variable-voltage reversing planer drive has overcome the objections to reversing motor-driven equipment not adaptable to all power circuits. It involves the use of a motor-generator set with an exciter, and a direct-current motor for the reversing drive. The cost of the equipment is less than that of the constant-voltage drive with a motor-generator set for use where direct current is not available.



Planer equipped with a 50-horsepower Variable-voltage Reversing Drive

The variable-voltage equipment has several advantages in common with the constant-voltage reversing motor drive, and it has other advantages wherein it is superior to the constant-voltage drive. The latter are as follows:

1. Simplicity and reliability of the equipment.
2. Effective and accurate stopping at the ends of the stroke.
3. Very smooth reversals at low and high speeds.
4. High efficiency on a short stroke, as well as on longer strokes.
5. No rheostatic losses in starting and braking resistors.
6. Quick reversals, resulting in less lost time at the ends of stroke.
7. Less over-travel required at the ends of stroke, as the rate of acceleration is higher and there is no resistor in the armature circuit to limit the acceleration if the tool starts to cut before the motor is up to speed.
8. Greater speed range than is obtainable with 230-volt constant-voltage equipment.
9. Emergency braking upon the failure of the power supply to the motor-generator.
10. Simplified control, the main circuit being opened only when the planer is not working.
11. Less burning of contacts, as only the generator field circuit is regularly opened under load.

The Westinghouse variable-voltage planer equipment shown in the illustration consists of a reversing planer motor, a motor-generator set, a panel for the field reversing contactors, field rheostats to obtain the proper speed on the cutting and return strokes, a contactor for the armature circuit between the generator and the reversing motor, a master switch operated by the motion of the table, and a pendant switch.

Power may be taken from any alternating-current circuit or from a 550-volt direct-current circuit. The electricity is converted from the available circuit into direct current by means of the motor-generator set. The exciter is used to energize the generator and motor fields and to supply power for the control circuit, the exciter operating at a constant voltage. The generator operates at the voltage required to obtain the speed desired on the cutting stroke, and, on the return stroke, the generator is operated at full field, the field of the reversing motor being weakened to obtain the desired speed.

The general characteristics of the reversing motor used in the constant-voltage system apply to the reversing motor of variable-voltage systems. It is built with an armature of small diameter, which reduces the time required to accelerate, stop, and reverse the motor at the ends of the stroke. Nearly all motors are connected to the main driving shaft of the planer through a flexible coupling, and the coils of the motor are thoroughly braced so as to resist the stresses set up at the time of reversal.

No accelerating resistance is used in the circuits, the inductance of the generator field being used to limit the accelerating current. On the larger machines, the fields can be designed for a lower voltage, so that there are fewer turns in the shunt field coils, and this, in turn, reduces the inductance and increases the rate of acceleration and deceleration. At the ends of stroke, the generator field is disconnected, and the reversing motor slowed down by regeneration through the motor-generator set to the power supply circuit. When at a relatively low speed, the generator field contactor closes, so that the generator supplies power to the reversing motor to cause it to rotate in the opposite direction. In this way, the amount of power per stroke is reduced to a minimum.

The field rheostats may be located where it is convenient for the operator to reach them to adjust the speed of the planer. The master switch is the same as that used on the constant-voltage equipment, and is operated by the shifting mechanism in the same manner. The pendant switch allows the operator to start, stop, and "inch" the planer independ-

ently of the shifting mechanism and the master switch. Upon the failure of power in the supply circuit, the reversing motor is quickly stopped by dynamic braking.

Comparison of Constant-voltage and Variable-voltage Drives

In the operation of a planer, the rate of removing metal is the proper measure of output, and the ability of any driving system to remove metal is dependent on the regulation of the power supply and the overload capacity of the motor. The speed of the motor and the rate of table travel are also important factors. Using the same reversing motor, constant-voltage and variable-voltage equipments can be compared as follows:

With constant-voltage equipment supplied with power from a generator of large size, such as may be found in a power house for supplying an entire shop, the limit of output is the short-time overload capacity of the motor. The torque, or turning effort, of the motor is proportional to the field strength times the armature current. As the field strength is increased to obtain slower speed, the ability of the motor to drive the planer through a very heavy cut is increased. For a short time, within the limits of heat absorption of the motor, this fact allows full output on hard spots at the slow speeds required to protect the cutting tools. At these heavy loads, the motor will maintain a very nearly constant speed. If the planer is being used for taking heavy cuts on very tough metal, the constant-voltage equipment will give more output.

With the same motor supplied with power from an individual motor-generator set, the voltage of the generator will decrease with an increase in load above the full load. The actual amount of voltage decrease will depend on the design of the particular generator and its compounding. This decrease in voltage will cause the planer motor to slow down with very heavy cuts, and thus limit the amount of load that may be carried for a reasonable decrease in speed. The larger the generator (supplying power to one or more planers), the more nearly will the equipment approach the output of equipment furnished with power from a power house.

With variable-voltage equipment, using the same frames as in the previous cases, the load that can be carried with the same speed reduction will be considerably less, the generator, working at a reduced voltage. The drop in voltage is the same number of volts as when working at full voltage, but the percentage is practically twice as great. Likewise, the slower the speed, the greater will be the percentage, because with a reduction in voltage for slow speed, the current is increased proportionately for the same horsepower, causing a further drop in speed until the motor stalls. Therefore, for heavy cuts the advantages of variable-voltage equipment, as previously given, must overbalance the limitations in output, to warrant its adoption.

By adjustment of the generator compounding, the reversing motor may be made to run slower under no load than under full load. This will allow the planer to be operated in such a manner that the tool will start cutting the work at a relatively slow speed and then increase in speed. This ordinarily is not advisable, as it means a loss of time when part of the cutting stroke overlaps the work.

On many planers, a very heavy cut that may cause a considerable overload can be taken. On constant-voltage equipment, this will not be noticed by any change in the motor speed, and the heat absorbed during the cutting stroke will be dissipated by the additional ventilation obtained during the high-speed return stroke. Trouble is seldom encountered with the heating of a reversing planer motor on account of these conditions. Hence, on a machine having a variable-voltage drive, a slow-down in the motor speed indicates that the motor is operating above its rated capacity.

* * *

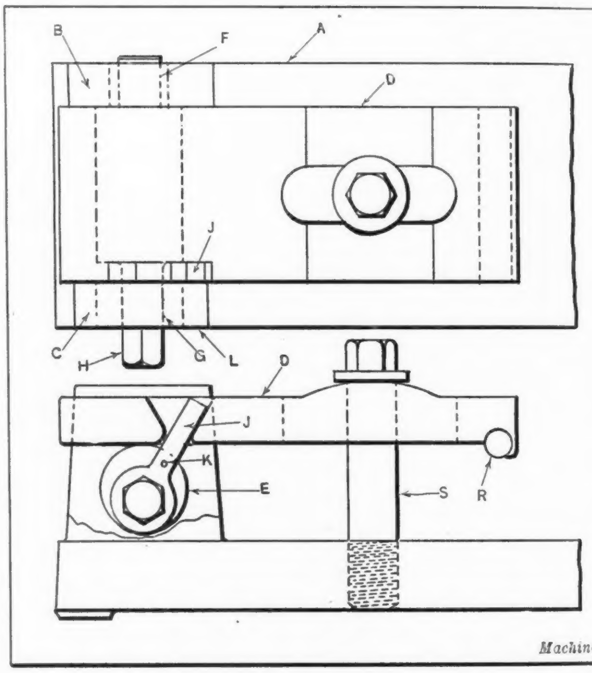
In June, 1924, there were 2351 electric railway locomotives in operation throughout the world. Of these 504 were in use on Italian railways, 465 in the United States, 366 in France, 304 in Germany, and 214 in Switzerland.

QUICK-ACTING CLAMP

By FRANCIS J. DITTMAR, Consulting Engineer, Buffalo, N. Y.

The quick-acting clamp shown in the accompanying illustration is designed for use on a drill jig or fixture. It has a cast-iron body *A* upon which two lugs *B* and *C* are cast. These lugs are machined on the inside to permit the clamp *D* to slide back and forth. It will be noted that the clamp has a radial face at the fulcrum point where the stud *S* passes through the slot. This prevents binding, and provides a good bearing, even when the work varies somewhat in size. This radial section also strengthens the clamp at its weakest point. A hardened piece of drill rod *R* is held in place at the end of the clamp by peening the soft metal of the clamp over the rod. The piece of drill rod receives all the wear and delivers an even pressure on the face of the work.

Pressure on the work is obtained by means of the cam *E*. This member is cylindrical, and has its two bearings *F* and *G* located 1/4 inch off center, which gives the clamp an effective range of about 0.1 inch. The range can, of course,



Quick-acting Clamp for Jigs and Fixtures

be varied to suit conditions. After the work has been placed in its nest, the clamp is advanced by turning a wrench which engages the hexagonal head *H* of the member *E*. Instead of a wrench, a handle is sometimes pinned directly to member *E*. The movement of the clamping wrench or lever actuates the finger *J* which engages the clamp in the slot, as indicated in the lower view, and thus pushes the clamping member forward and raises its outer end. When finger *J* has moved the clamp to its desired position, the cam will have delivered the required clamping pressure.

Referring to the illustration, the lug *C* is broken away to show the arrangement of the finger-lever, which is a press fit on the bearing *G* and is keyed to the cam by the pin *K*. It is obvious that the position of finger *J* with respect to the high point of the cam must be correct. The small pin *K* should not be located until the clamp and cam have been properly adjusted or timed. The bushing *L* is made somewhat larger than the bushing in the other lug in order to permit the cam to be inserted.

* * *

Steel flasks for foundry use have recently been produced by electric welding, and are said to stand up better under the hard usage that they receive in foundry work than flasks made from wood, cast iron, or riveted steel. With electrically welded flasks, there is no chance of the pieces coming apart.

POLISHING IN THE CUTLERY INDUSTRY

Polishing is an important operation in the manufacture of cutlery. However, polishing practice differs considerably in the production of different types and grades of cutlery. Butcher and paring knives, as well as table knives that are not silver-plated, are now generally polished on a double-header type of polishing machine. These machines are provided with two polishing wheels, which run toward each other, so that the knife is drawn in between the wheels, as indicated in Fig. 1, which illustrates a machine built by Hemming Brothers Co., New Haven, Conn.

The double-header polishing machine, when used for the cheaper grades of table knives and kitchen and butcher knives, is usually run at a speed of 500 revolutions per minute for a 24-inch diameter wheel. The knives are first ground on automatic grinders, using No. 60 grit solid ring grinding wheels. They are then ground on grindstones having about the same coarseness as No. 120 emery, after which they are ready for the double-header polishing machine. The wheels used in this machine are compress canvas wheels, 24 inches in diameter, 1 1/2 inches wide, having a cushion of extra soft density 3 inches deep. A soft cushion is required so that it will yield enough to adjust itself to the shape of the blade.

The wheels used for the rough-polishing operation are set up with a paste head of glue and emery for which either No. 160 or No. 180 emery should be used. Usually the knives are passed through twice. For finishing or coloring, fine emery such as No. 4F is suitable, the method of performing the finishing operation otherwise being similar to the rough-polishing. Sometimes, especially if a higher grade of finish is desired, three operations instead of two may be needed on the double-header machine. In such a case, the abrasive should be No. 150 for the first roughing, No. 220 for the second roughing, and No. 4F for coloring or finishing.

In order to obtain the best results with an automatic double-header machine, care should be taken to keep the wheels running as true as possible and not to exceed the recommended wheel speed. Instead of using a compress wheel, cutlery of the unplated kind may be colored by using a sewed buff to which any suitable coloring material, such as Vienna lime, crocus, rouge, or special compositions, is applied.

Polishing Pocket Knife Blades on a Double-header Machine

When polishing pocket knife blades on a double-header machine, formed-face wheels greatly facilitate the polishing process. Fig. 2 shows the shape of formed-face wheels used for polishing pocket knife blades and springs. At the left is shown diagrammatically how the tang end of the blades

Fig. 1. Double-header Polishing Machine used for finishing Pocket Knife Blades

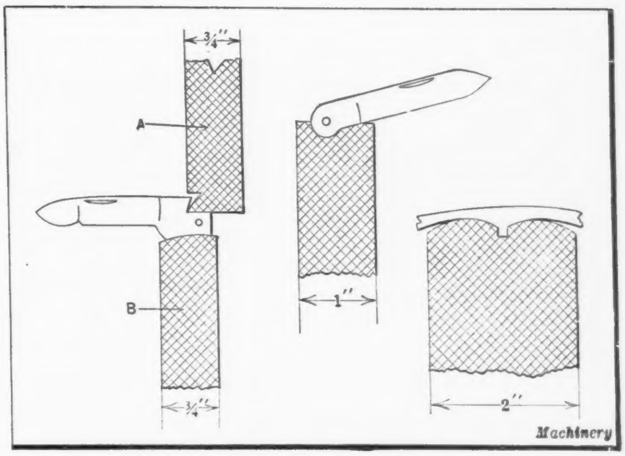


Fig. 2. Diagrams of Formed-face Polishing Wheels for finishing Pocket Knife Blades and Springs

would be polished in a double-header machine. Wheel *A* is mounted in a stationary position, and wheel *B* is permitted to rock and adjust itself to the curvature of the work. These wheels are 14 inches in diameter, 3/4 inch wide, and are constructed of compress leather with a 2-inch cushion of medium density. Formed-face wheels used as shown in the center of the illustration are usually made 14 inches in diameter and 1 inch wide. These wheels are of a hard density compress leather, having a 2-inch cushion depth.

The wheel to the right in the illustration is used for polishing the inside of knife springs. Wheels for this purpose are generally made of compress leather, 14 inches in diameter, 2 inches wide, with a 2-inch deep hard density cushion. The backs of the springs are polished on flat-faced wheels of the same material and of extra hard density. The illustration shows the possibilities for economically finishing knife blades by the use of formed wheels.

It is not always the practice to polish the cheaper grade of table knives on a double-header machine, because in many plants use is made of an automatic glazing machine, which reciprocates the knife over the face of the machine and at the same time imparts a rocking motion to the work as required for following the convex surface of a table knife blade. For silver-plated table knives of the solid handle type, the automatic glazing machine is generally used, and an extra hard density compress leather polishing wheel is regularly employed. These wheels have a 2-inch depth of cushion, a face width of 1 1/2 inches, and a diameter, when new, of 24 inches.

* * *

WHAT COUNTS IN ADVERTISING

Some comments on advertising that are as applicable to the machine shop equipment field as to the general merchandising field, are made by the advertising agency Lord & Thomas in an advertisement in the New York *Times*. Reference is made to so-called "clever" advertisements, and it is stated that few advertisements which embody the common-sense simplicity that sells goods ever gain that eulogy. To quote: "An advertisement may attract, entertain, or amuse a million people—and not sell one. 'Clever ads' are usually a mark of inexperience. Most beginners in advertising start by being 'clever.' Those who stay and succeed do so by learning that 'cleverness' is a costly folly. A good advertisement attracts by its news value, convinces by its simplicity, and sells by creating a desire through common-sense appeal. Only those who understand that simple principle in advertising can produce advertisements that register in sales. Look through the current issues of magazines, note how successful advertisers, those seasoned in advertising experience, hold unfailingly to that principle. Note their lack of tricks and frills; mark their sincerity, their freedom from the bizarre. They head for one goal, that's a sale. They talk about the product they are aiming to sell, not about extraneous things."

Press Work in Agricultural Machinery Plants

Drawing Dies Employed in Producing Two Sheet-steel Parts for Farming Machinery—Third Article of a Series

By C. C. HERMANN, President, Hermann Associates Inc., Engineers, Rock Island, Ill.

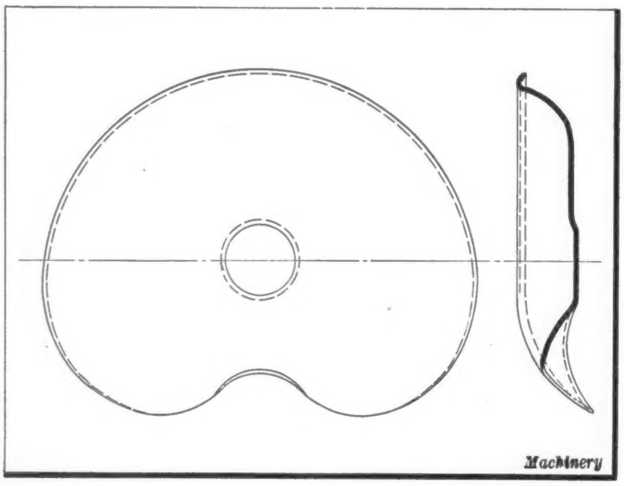


Fig. 1. Seat provided for the Driver on Many Types of Agricultural Machinery

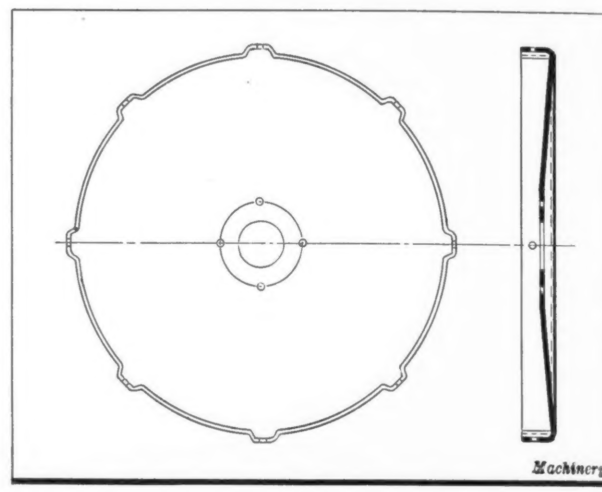


Fig. 2. Pressed-steel Head that is blanked and drawn in a Double-action Press

MANY types of agricultural machinery that are driven back and forth across fields are provided with a seat for the driver of similar design to that illustrated in Fig. 1. In the past such seats have been largely gray or malleable iron castings, but it has been found much cheaper to make them from sheet steel. In addition to economy, the sheet-steel seats are much stronger than cast ones. The seat shown in Fig. 1 is of the former type, and the dies employed in drawing this seat will be described in the following. The large diameter of the seat averages 18 inches; the small diameter, 15 inches; and the depth, 4 inches. From No. 16 to No. 14 gage stock is used.

Dies for Producing the Seat

A combination blanking and drawing die used in a double-action press of large capacity for producing the seat shown in Fig. 1 in one operation is illustrated in Fig. 3. On the descent of the punch ram, the blank is cut to size as punch *A* passes the upper trimming edge of die *B*. Punch *A* then acts as a blank-holder, gripping the work between it and die *B* during the drawing of the seat. The drawing is accomplished by means of punch *C* and die *D*, which are machined to suit the contour of the finished piece. Die *D* is backed up by heavy coil springs *E*, contained in recesses bored in the die and in the baseplate beneath. On the return stroke of the ram, these springs raise the die and bring the finished seat on a level with the top of member *B* so that it may be conveniently removed by the operator.

Punch *A* and die *B* may be made solid, as shown, or provided with narrow shearing rings that may be replaced cheaply when repairs are necessary without renewing the entire parts. Spring-back in the metal of this seat after the operation does not make any material difference, but with many parts, allowance must be made for spring-back.

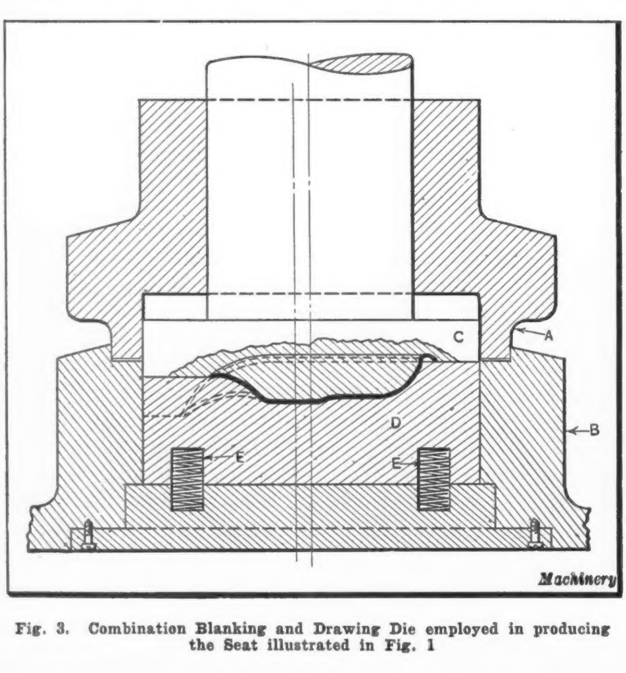


Fig. 3. Combination Blanking and Drawing Die employed in producing the Seat illustrated in Fig. 1

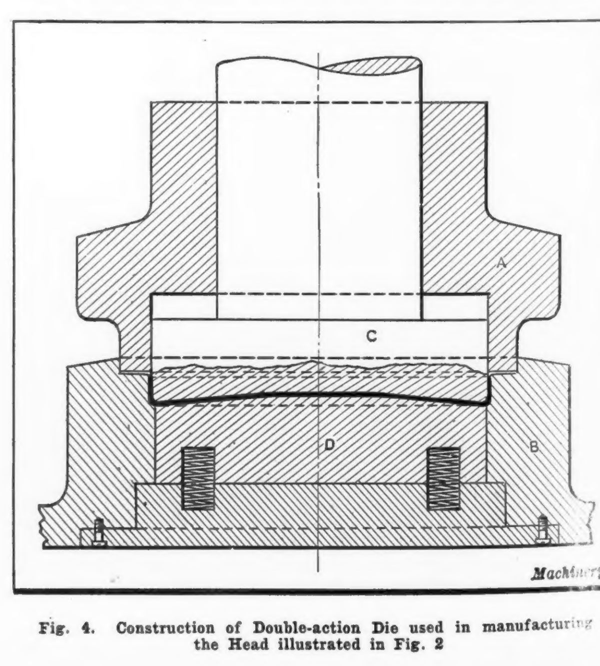


Fig. 4. Construction of Double-action Die used in manufacturing the Head illustrated in Fig. 2

When it is desired to perforate the seat, as is done in many instances, the seat is blanked and perforated in an operation separate from that of drawing. The drawing die for such an example would be similar to the one shown, with the exception that the shearing provisions would be left off. The drawing operation could then be performed in a single-action press equipped with the die illustrated in Fig. 5. To give long life, it would be preferable to line the working faces of the punch and die with tool-steel pieces which could be easily replaced. No ejector is required with this die, as the seat can readily be removed without one.

In both dies illustrated, the punch and die elements are entirely separate, and for this reason must be accurately lined up on the punch press at each set-up. Much trouble from mis-alignment could be avoided by the use of guide pins. Four pins made of 2-inch round bars could conveniently be secured in the die-block to slide in bushings contained in one of the punch members. Such a die set can be easily set up without binding between any of the members.

Combination Blanking and Drawing Die for a Steel Head

Another part commonly used in agricultural machinery is the pressed-steel head shown in Fig. 2, which is approximately 18 inches in diameter. The head is fastened on each end of a long cylindrical piece. It was customary in the past to use an iron casting for this part, but as it can be produced from steel in a power press at less than one-half the cost of casting, steel heads are now being being rapidly adopted. The steel parts also have the advantage of greater strength. From the plan view it will be seen that the head has a comparatively large central hole, surrounded by four small holes. The latter are used in riveting a cast hub in the center. At eight points, equally spaced around the head, recesses are formed to receive bars, and in each recess there is a hole by means of which the bar can be bolted in place. In order to increase the end resistance of the head, it is slightly dished, as shown in the sectional view.

Three operations are performed in producing this head; in the first, the part is blanked and drawn; in the second, the central hole is punched; and in the third, the holes around the flange are punched. The first and second operations could be combined if a die set were used that would complete the drawing before the piercing of the hole was started, but if this timing were not followed, the central hole would be distorted. This would also be the case if the central hole were punched before the drawing; however, the distortion would not be serious in the latter case.

The combination blanking and drawing die shown in Fig. 4 is used in a double-action press for the first operation on the head. The blank is cut to the proper diameter as punch A enters die B. Punch A then grips the metal between it and die B as punch C comes in contact with the blank and pushes it into the die, the drawing being completed when die D reaches its lowest position. This die member is also equipped with coil springs which hold it firmly against the work during the descent of punch C and raise it at the end of the operation to eject the work from the die. When the punch ascends, die B acts as a stripper to pull the work from member C. In order to reduce replacement costs and to facilitate grinding, punch A and die B could be provided with shearing rings made of tool steel, as in the case of the first die described. Block D can be made of gray iron, but it is preferable to use a semi-steel casting.

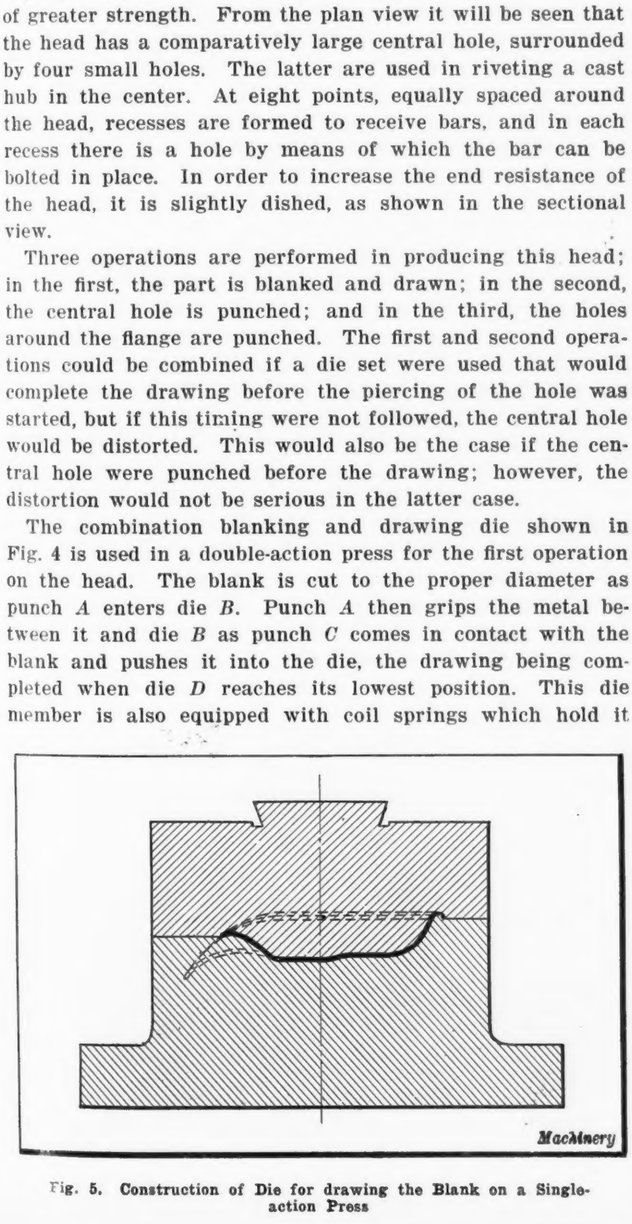


Fig. 5. Construction of Die for drawing the Blank on a Single-action Press

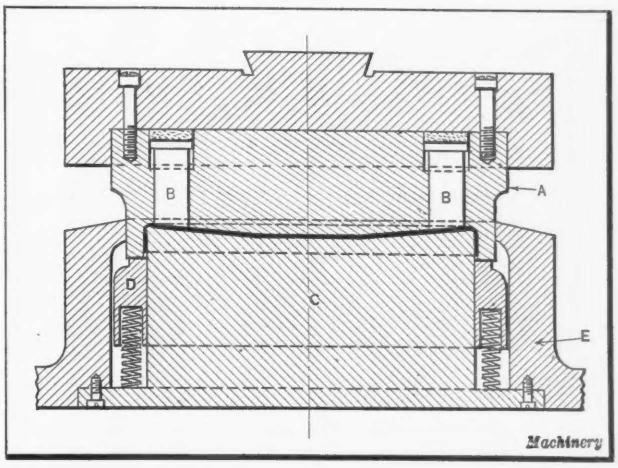


Fig. 6. Combination Blanking and Drawing Die used for performing Two Distinct Steps in One Operation in a Single-action Press

Making the Head in a Single-action Press

If a double-action press were not available for manufacturing the head, it could be produced in a press of the single-action type equipped with the die illustrated in Fig. 6. In this die, the work is drawn with the flange down instead of up, the reverse of the method used in the double-action press. Ejectors are required on both the punch and die of this set. Punch A is, again, a combination blanking and drawing member, the blank being sheared as the punch enters die E, and then drawn by the recess at the center of the punch as the downward stroke of the press ram is completed. Near the end of this operation the center part of the work is stretched slightly. The blanking edge of the punch should be sufficiently in advance of the drawing recess so that the shearing operation will be completed before the drawing is started. Ejectors B of the punch are backed up by rubber pads in the die illustrated, but springs could also be used for this purpose.

Block C of the die is equipped with an ejector ring D, actuated by coil springs. To accommodate this ejector, die-block E is under-cut on the inside. A disadvantage of this design is that scale can accumulate in the crevice between ejector D and die-block E and render the die inoperative. It is desirable to oil all moving parts of such a die, and this is a factor that increases the scale trouble because oil on scale makes it cling so tenaciously to the metal parts that it cannot be readily blown out by compressed air, even if ports are incorporated in the die for this purpose. In order to remove this scale, it would be necessary to dismantle the die from the machine, and for this reason a double-action press is preferable for this class of work. Of course, the blanking and piercing could be done in one operation prior to the drawing, which would permit the use of a drawing die designed without part E so that ejector D would be entirely visible and accessible for cleaning without removing the die from the machine.

* * *

Three huge nuts have recently been ordered from the Bethlehem Steel Co. for the propeller shafts of the steamship *Malolo* which, when completed, will be the largest and fastest high-powered passenger steamship ever built in the United States. These propeller shaft nuts each weigh 1460 pounds. They are 2 feet 4 1/4 inches across and are 12 1/4 inches thick.

Milling Turbine Impulse Blades

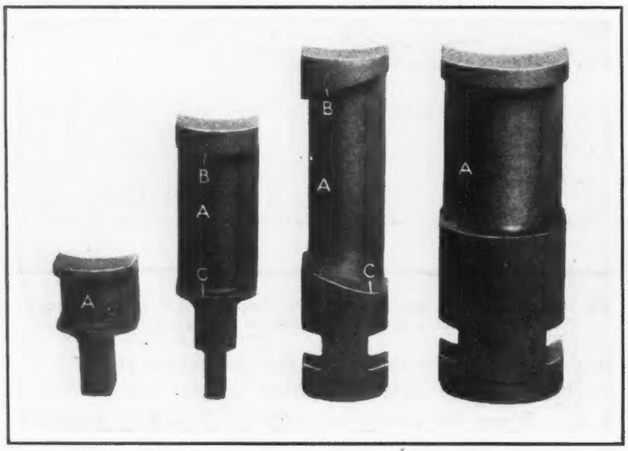


Fig. 1. Impulse Blades installed in the Rotor and Stator of Steam Turbines

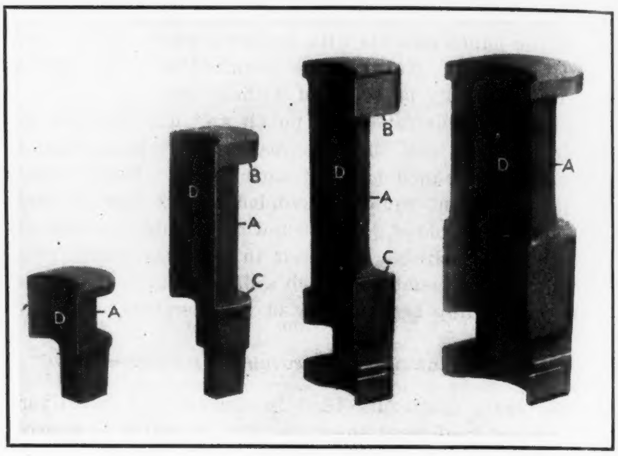


Fig. 2. Another View of the Turbine Impulse Blades illustrated in Fig. 1

IMPULSE blades for steam turbines must be accurately made, in order to insure that they will direct the steam properly, and also so that they can be assembled without difficulty into the rotor and stator of the unit. In the turbine blade department of the Westinghouse Electric & Mfg. Co., which was recently moved from the East Pittsburg Works to the South Philadelphia Works, one of the most interesting operations consists of finishing port *A*, Figs. 1 and 2, of the impulse blades. These surfaces are rough- and finish-milled on a machine of standard design equipped with special devices. At any point along surface *A* the top of a cross-section would be round with the sides sloping from the round at angles that differ with the blades. The top or the angular sides of surface *A* may run straight in the lengthwise direction or be straight for a certain distance at the middle of the part and then incline to surfaces *B* and *C*. The blades are made from electric furnace steel containing 5 per cent nickel.

Figs. 3, 4, and 5 show a continuous or drum type of milling fixture and the cutters used for the operation. The pieces of work *E* are held in place by clamps *F*, of which there are eight rows spaced equidistantly around the drum. The number of blades in each row, as mounted on the drum, depends upon the length of the blade. As set up in these illustrations, there are five blades in every row, so that the drum holds forty blades at one time. When the blades reach this operation, they are finished all over, except for surface *A*, Fig. 2, and so it is convenient to locate the parts by seating surface *D* on a hardened block arranged in line with the clamps. Blocks also prevent the blades from moving endwise. The arbor on which the drum is mounted is driven counter-clockwise through gears, knuckle joints, and a telescopic shaft which connect the drum to the gear-box mechanism of the milling machine.

On the two ends of the drum, as shown at *G* and *H*, Fig. 3, there is an eight-pointed cam, the points of which hold an inserted piece of hardened steel which is shaped to correspond with the contour of surface *A* (Fig. 2) of the work at the middle of the surface. The distance from the center of the drum to the top of each inserted piece is the same as the distance from the drum center to the top of surface *A* on each piece of finished work. On the right-hand side of the drum, as shown in Figs. 4 and 5, there is an arbor *J* on which five sets of interlocking cutters are arranged in pairs to mill the work as it is rotated past the cutters. The latter also rotate counter-clockwise.

At each end of arbor *J* there is a roller *K*, Fig. 4, which contacts with the eight-pointed cam on the work-drum. The latter is arranged to slide longitudinally on the table of the machine according to the movements imparted to it by the rotation of the cams against rollers *K*, the cams being held against the rollers by pressure exerted on the drum slide from an air cylinder located at the right-hand end of the machine table. In front of the cutter-arbor, there is another arbor on which rollers are mounted on each end to contact with rollers *K* directly opposite the cams, and thus support

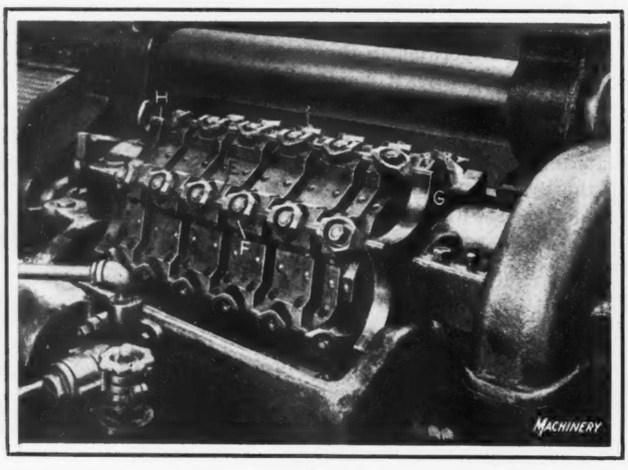


Fig. 3. Continuous Drum Milling Fixture equipped with Cams which control the Contour of the Surfaces milled

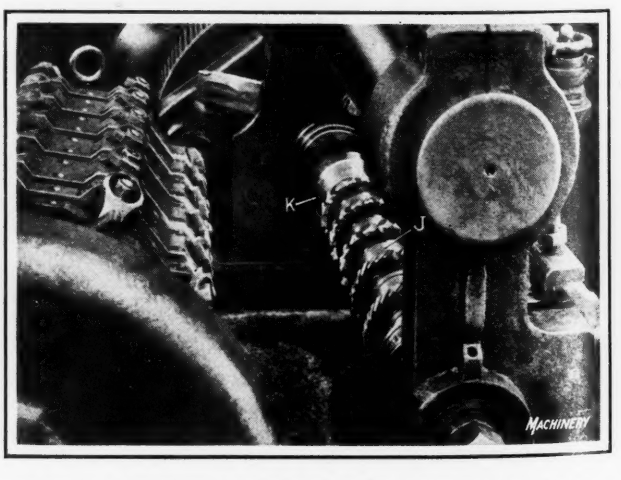


Fig. 4. Work-drum withdrawn from the Cutter-arbor to give a Clear View of the Cutters

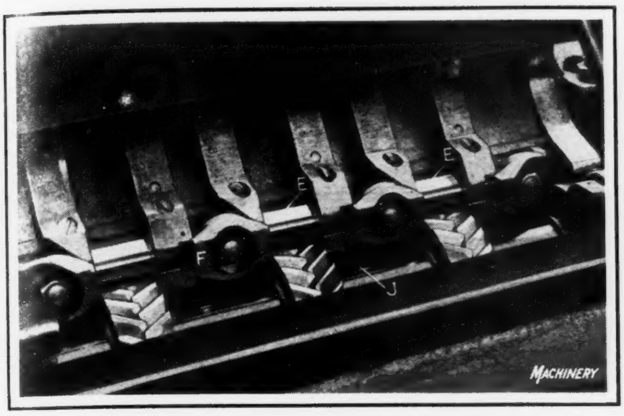


Fig. 5. Close-up View of the Milling Operation

the cutter-arbor against the thrust developed in the operation. Rollers K must always be ground to the same diameter as the cutters in order to produce the ports within the limits of accuracy specified.

There is also a transverse slide for the work-drum and a second air cylinder arranged near the left-hand end of the milling machine table, for moving the drum transversely whenever surfaces B or C, Fig. 1, must be cut at an angle, as in the case of the third example shown from the left-hand side of this illustration. To regulate these transverse movements, a pair of face-cams is mounted on each end of the drum inside of the pointed cams, and the drum is moved back and forth transversely as the surface of one cam of each pair revolve against the surfaces of the mating cam. The pressure of the air cylinder holds the two cams of each pair in contact. Opposite transverse movements of the work-drum are obtained by simply admitting air in the cylinder on opposite sides of the piston.

With impulse blades in which surfaces B and C are both at an angle, each piece of work must be revolved past the cutters three times in both the roughing and finishing operations. During the first pass, surface A is milled with sides B and C straight; then during the second pass, the drum is operated transversely, either forward or backward, for milling side B or side C; and finally, during the third pass, the drum is operated in the opposite direction for milling the remaining side. Both air cylinders are equipped with an 8-inch piston and the air pressure averages 50 pounds per square inch.

As the different rows of finished parts revolve upward on the left-hand side of the drum, the clamps are loosened and then the operator turns a small handwheel in the center of the drum at the front end, which causes pins to raise the pieces of work so that they can be easily removed. Coolant is supplied copiously in this milling operation, not only to cool the work and the cutters, but to insure the washing away of all chips.

* * *

COST OF HIGHWAYS

According to an address made by Alfred Reeves, general manager of the National Automobile Chamber of Commerce, before the Portland Cement Association, the taxes paid by the steam railroads annually toward highway improvements amount to $35,000,000, or slightly less than 4 per cent of the total cost of highway building in 1924. On the other hand, the railroads collect twelve times this amount for carrying automobiles, gasoline and road materials, to say nothing of the raw materials that go into the building of automobiles and trucks. The total highway bill of the United States amounts to about $1,000,000,000 annually. Of this about one-half is accounted for by the special taxes paid by automobile and truck users. The remainder comes out of general taxation, or is met by deferred bond issues. A large part of this general taxation and of the interest and amortization on the bond issues is, again, to a large extent, borne by people who are owners or users of motor vehicles.

GRINDING DUST EXHAUST SYSTEM

By CHESTER LYNNDELLE

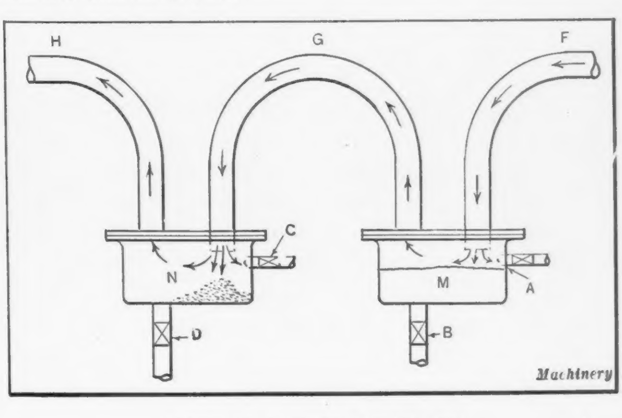
Practically every plant having a grinding department utilizes an air exhaust system to carry away the dust and grit formed at the abrasive wheels. The disposal of the dust-laden air, however, often proves to be as great a problem as that of removing the dust from the machine. One plant engaged in light manufacturing attempted to use air bags similar to those furnished with household vacuum cleaners, but these proved unsatisfactory and a substitute was found in the air cleaner system shown in the accompanying illustration, which is an adaptation of that used on gasoline engines.

At the lowest point in the suction line F leading from the grinding wheels, there was placed a cast-iron tank M, with a siphon control which kept the water level at a point two inches below the lower lip of the suction line. The exhaust pipe G is continued vertically from the tank cover and provided with a gooseneck bend and a dry tank N located at a point just in advance of another reverse bend H leading to the blades of the suction fan.

The first settling tank M catches most of the larger particles when the tangential force carries them out of the sharply deflected air current and traps them in the water before they can be caught up again. At the same time, the vibration sets up tiny concentric wavelets, the crests of which are atomized and drawn up by the outgoing air. The moisture causes the fine particles that remain to agglomerate, so that when they reach the second sharp turn they are thrown off and collected in the dry tank N, as indicated in the illustration.

When the exhaust air reaches the fan, it contains practically no moisture, and is so free from dust that it can be discharged into the open air. After more than two years of service, a system of this kind has not carried out dust enough to stain the nearby walls. Water for the first, or wet, tank was originally fed into the tank at a point A somewhere above the predetermined water level, but this arrangement was found to moisten the air unevenly. This trouble was remedied by locating the water inlet near the bottom of the tank.

A flush-out valve C is provided for the dry tank N, which is used only when a diminution of suction at the grinder indicates that the system is becoming clogged. The tanks M and N can be drained into the sewer by opening the valves B and D. The covers of the tanks are held in place by C-clamps, and can be easily removed to permit the tanks to be cleaned. The improved tank system requires cleaning at weekly intervals, whereas the air bag system required cleaning each day or, at best, three times a week. Originally, ordinary pipe with cast-iron fittings was used for the system, but the wear at the abrupt turns was so great that formed pipe was substituted. When the exhaust material contains a by-product which may be reclaimed, the new method is particularly desirable. It has been found that the washing of the air also greatly extends the life of the exhaust fan and the exhaust piping.



System for collecting Grinding Dust

Butt-welding Multi-throw Cranks

By A. M. LOUNT, Master Mechanic, Massey-Harris Co., Ltd., Toronto, Canada

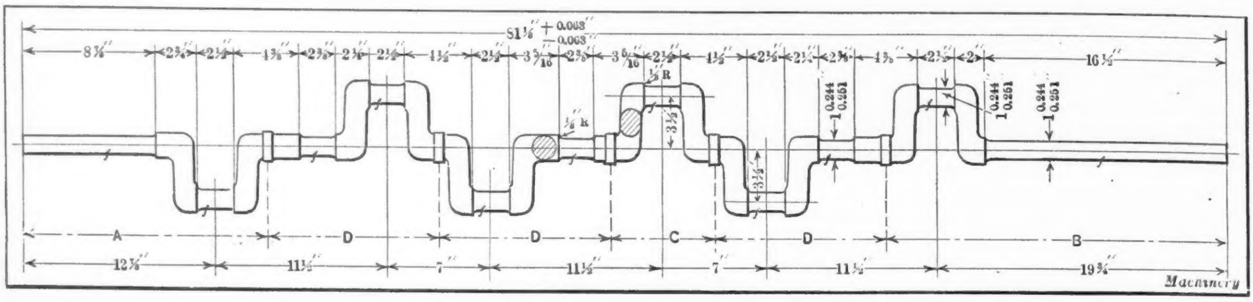


Fig. 1. Six-throw Crank made by butt-welding Six Sections, after machining the Pins

A METHOD of manufacturing multi-throw cranks by electrically butt-welding together single-throw sections was described in October, 1924, MACHINERY, page 144. The cranks produced by this method were not machined, except for the drilling of a hole near one end, and no great accuracy was required in forging. Strength, however, was essential, and this was obtained. After establishing this economical method of producing a strong forging, it was decided to utilize it in conjunction with lathe operations to simplify the production of six-throw cranks requiring greater accuracy. These cranks, like the ones previously referred to, are used for certain classes of agricultural machinery. They are formed of six sections, which are welded together after the pins have been turned.

As Fig. 1 shows, there are six turned pins, three turned center line bearings, and two turned outer bearings. The tolerances are rather large, as shown in the illustration, and as the alignment of one pin with another need not be absolute, the sectional method of production has proved to be satisfactory. The composition of the steel used conforms to specification No. 1020 of the Society of Automotive Engineers. Each crank is formed of one section *A*, one section *B*, one section *C*, and three sections *D*. The various operations required will now be described in the order in which they occur.

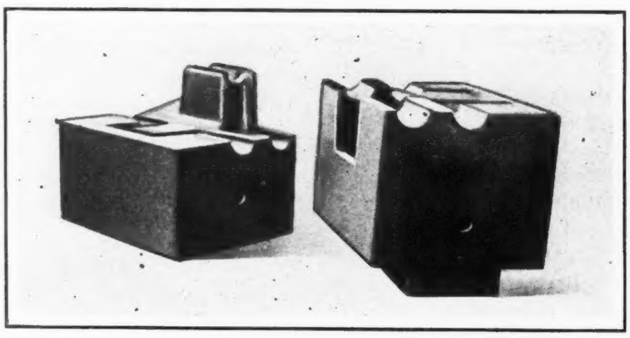


Fig. 2. Dies used for drop-forging the Crank Sections

Cutting off Stock, Bending, and Forging Sections

The stock is cut to the required lengths on a standard bar shear. All sections are bent prior to drop-forging by using a bulldozer for the "breaking down" operation. This bulldozer is equipped with cast-iron dies, and the stock is heated in an ordinary oil-burning furnace.

The drop-forging which follows is done with a 750 pound board drop-hammer. An oil-burning furnace is again used for heating, and all sections are forged by using the same dies. The dies shown in Fig. 2 have produced 20,000 sections. These dies were made of carbon steel, hardened and drawn. No trimming operation is necessary in connection with this drop-forging.

Turning Pins and Cutting off Sections

The pins of the various sections are next turned, filed, and polished in a standard 18-inch engine lathe. One end of the section is held by a special fixture mounted on the lathe spindle, and the outer end is supported by an arm (shown at *A*, Fig. 5) which rotates on a bearing or mandrel inserted in the tailstock spindle. The crank section is, of course, clamped in the fixture and arm so that the pin to be turned is in line with the lathe axis.

A revolving or turret type of tool-holder is used for the turning operations. Position No. 1 has two tools (as at *A*, Fig. 3) so spaced that each tool rough-turns one-half the length of a pin; hence the turning time is reduced to approximately one-half what would be required with a single tool. In position No. 2 a single tool is used for taking a light finishing cut at a comparatively high speed (see diagram *B*). In position No. 3 there are two tools for finishing the shoulders and forming fillets at the pin ends, as shown in diagram *C*. Hand filing and polishing with abrasive cloth completes this operation. The total time from floor to floor is about six minutes.

The sections are next cut to length by using two high-speed power hacksaws. One machine has a block fastened

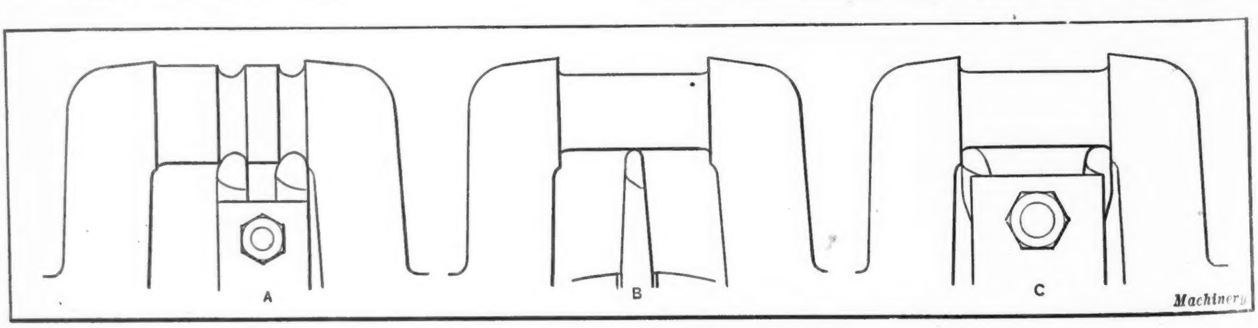


Fig. 3. Three Turning Operations on Pins

to the stationary vise jaw. This block engages the turned shoulders of a pin and acts as a gage for regulating the length of the short ends of all sections. The other hacksaw has a similar gage-block beyond the vise for gaging the long ends of sections *D*, Fig. 1. The long ends of sections *A* and *B* are cut off in connection with the following operation, which is a combination of three minor operations.

The ends of sections *C* and *D* and the short ends of sections *A* and *B* are next rounded (see Fig. 4 which shows one of the sections *D*). This rounding of the ends is done to facilitate welding the sections together. The work is held in a fixture mounted on the lathe spindle, and a formed tool is used to produce the spherical end.

The long ends of sections *A* and *B*, Fig. 1, are next cut to length in a lathe. The work is held by a fixture on the spindle and by a steadyrest which supports the outer end. A steel sleeve is placed over the rough stock to provide a steadyrest bearing. These long ends are next turned to a diameter of 1 1/4 inches for a length of 1/2 inch to provide a starting surface for the box turning tool that is used later for turning these ends.

Welding the Sections Together

In building up the crank, two sections are welded together at a time, using a butt-welder having special clamping and gaging attachments. The complete welding fixture consists of two separate units, there being a left-hand or stationary unit, and a right-hand or moving unit. These units are practically the same, but of reverse hand. The unit has a heavy cast-iron base with a swinging clamp arm which is drawn downward for clamping by a latch, an eccentric and a hand-lever. A gun-metal frame straddles the base and is bolted to the platen of the welder. This frame carries a copper die and three steel gage-blocks, the latter being used to positively locate the turned pins in the right position.

Two inner sections, such as *DD* or *CD*, Fig. 1, are first welded together. As the work heats, it is advanced until a positive stop is encountered. As soon as the weld has been made, the work is taken to an anvil, where it is hammered lightly around the outside of the weld. While the weld is hot the work is placed under a straightening press, where it is revolved and, if necessary, straightened. The weld is next ground (while still hot) so that the diameter is only slightly larger than the original stock diameter. The inner sections *DD* or *CD* are permitted to cool before adding the outer sections *A* or *B*, because the gage-blocks of the welding fixture are adjusted too close to allow for the expansion of the heated sections. The central weld is the last of the five to be made.

Turning Ends and Line Bearings

The ends of sections *A* and *B* are turned by using a lathe equipped with a special "pot chuck" and a box turning tool, the tailstock being removed. The box turning tool is of the two-roller type, and is mounted on an angle-plate bolted to the lathe carriage. The pot chuck, which is about 5 feet long, is supported at one end by the lathe spindle, and at the outer end, by a babbitt-lined bearing mounted on the lathe bed. The crank is held at the spindle end by a hardened steel bushing, and at the outer end by a screw clamp with brass jaws which engage the turned pin nearest to the end to be turned.

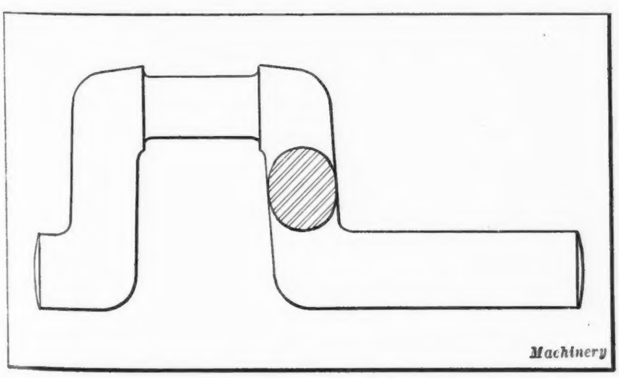


Fig. 4. Detail View of One of the Sections D in Fig. 1

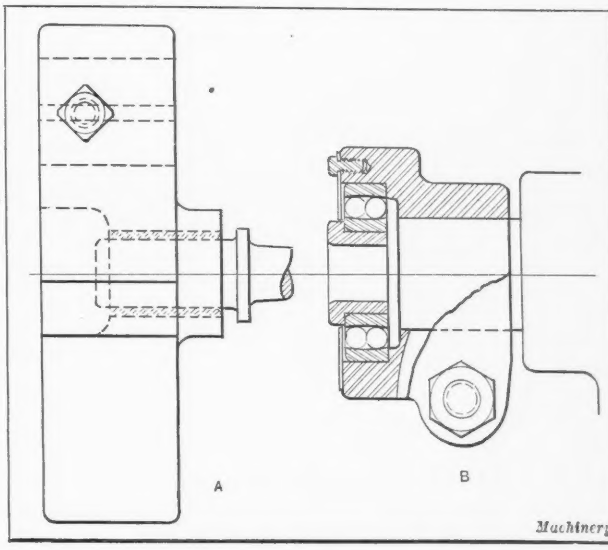


Fig. 5. (A) Revolving Support for turning Pins; (B) Revolving Support for turning Center Line Bearings

The three line bearings of the three sections *D* are next turned. The pot chuck used for holding the crank is like the one just described, except that it has two center bearing clamps with brass jaws. One of the turned ends is placed within the chuck, most of the crank extending beyond it. A standard steadyrest supports the work at the opposite end and as near as possible to the bearing being turned. The tailstock is provided with a revolving center equipped with ball bearings, as shown at *B*, Fig. 5. A turret toolpost carrying a roughing and a finishing tool completes the equipment.

After the first inner bearing is turned, the crank is moved farther into the chuck to bring the next bearing into the position. The two extra center bearing clamps previously referred to are used to hold the turned end and the first bearing to be finished in line with the second bearing, which is about to be turned. When the second bearing is finished, the crank is again shifted, and the third or final inner bearing is machined. Limit gages are provided for these operations.

The cranks are now taken to a final testing and straightening stand, where they are inspected and straightened, if necessary. The equipment described in the foregoing is capable of producing twenty-four cranks in eight hours. While this method of manufacture would not be suitable for cranks requiring a high degree of accuracy, it has proved entirely satisfactory for this particular class of work. The adoption of the method outlined made it possible to use inexpensive forging dies and machining equipment.

* * *

The hydro-electric steering gear of the airplane carrier *Saratoga*, has successfully passed a rigorous acceptance test in the shops of the American Engineering Co., Philadelphia, Pa. The gear, which weighs 110 tons, is the largest ever built. Four double-ended rams, 24 inches in diameter, moving in hydraulic cylinders, operate two links that run aft to the rudder. Oil, which is used as the hydraulic medium, is forced into these cylinders by Hele-Shaw hydraulic pumps, direct-connected to electric motors. The pump and motor units are arranged in two independent sets which can be used selectively, and provision is made for a quick change-over from one unit to the other. The tests showed that the gear can deliver a twisting moment of about 6,000,000 foot-pounds on the rudder post. The *Saratoga*, on which the gear will be installed at the plant of the New York Shipbuilding Co., Camden, N. J., is 895 feet long; a speed of 31 knots is specified.

FORMULAS FOR DETERMINING VALUE OF SPECIAL TOOLS

By D. W. WRIGHT, Tool Engineer, Saco-Lowell Shops, Lowell, Mass.

The writer has been in close touch for a number of years with the design and production of special tools, and until recently has known of no practical accounting basis that could be used to decide the question of whether or not special tools were warranted for a given job. In cases of intensive production, it is usually obvious that special tools will pay, and they are, of course, needed to insure interchangeability. In shops where a large line of machinery is produced, however, many parts are made only intermittently and in comparatively small quantities. In such cases, care should be taken to see that special tools are not made unless the designer is reasonably sure that they will at least pay for themselves. If the tools will not pay for themselves, the added expense will, of course, be a burden that must be carried by the other products.

After considerable thought and experimenting, together with a careful study of the work others have attempted along this line, the writer worked out formulas that have proved very satisfactory by means of which practical estimates can be made on special tool requirements. Special small tool equipment such as here referred to includes jigs, fixtures, punch press tools, gages, and single-purpose machines. How to determine beforehand whether such special tools will pay for themselves or not, has been, generally speaking, a matter of judgment and experience rather than a problem of accounting. The reason that no accepted method of computing such costs has been commonly used is probably because so many variable factors are involved.

Before making any application of principles, it is well to consider several of the factors that govern the making of special tools, such as the following: The degree of accuracy required, the practical value of such accuracy in the finished product, the saving of time in future machining or assembling operations, and the saving in power and material by providing more rigid or secure holding means. The saving in machining time, which permits the machine tools to be released for other operations, should also be taken into consideration. All these factors are tangible, and can be quite closely estimated. In fact, in order to determine the advisability of making investments in a set of new tools, it may be necessary to consider all the factors enumerated. The estimating of the value of each factor, however, must be done by someone familiar with all the details.

Different methods are used in setting the valuation of special tools when computing the assets of a concern. Some companies do not include such equipment in their inventories. Other companies maintain that special tools should pay for themselves in one year, while others allow two or three years' time. First impressions would seem to indicate that if the problem is to be considered one of real accounting, instead of a mere estimate, we must accept special tools as positive assets having a certain valuation so long as the company owning them is a going concern, and place percentage allowances on them at figures consistent with their use.

On the other hand, except in rare cases of the most intensive production, the use of special tools is quite different from that of machine tools and other equipment in constant use, in that a large number of the particular operations for which special tools are used may be completed in a comparatively short time. The tool must then lie idle for the remainder of the year. Now if the value of the jig is based on the proportion of the year that it is in actual use, as is the practice with other equipment, the results may be so distorted as to be of no value. For this reason, it is considered better to establish a fixed short period in which the special tools are required to pay for themselves, and allow a corresponding percentage of their cost for the period in which it is assumed they will become obsolete.

In November, 1923, the Material Handling Division of the American Society of Mechanical Engineers prepared a paper on "Formulas for Computing Economics of Labor-saving Equipment," which covers the subject in a thorough manner. The conditions are somewhat different, however, in the cases under consideration, and we have taken the liberty to make slight changes to suit our requirements in making up the formulas and values. Before referring further to the formulas, the writer will quote from the paper mentioned.

"The whole problem is considered to be one of comparative costs. While it has been customary in the past to charge factory burden or factory overhead to the labor-saving device, it has not been customary to credit the device for its portion of the saving on overhead expenses, which generally is proportional to the difference in labor costs, since there is usually a definite relation between labor and overhead.

"In computing the costs, the labor to be saved has frequently been classed as indirect or non-productive labor, and as such is a part of the overhead or burden. It should not, therefore, bear any superimposed charge from the other components of the overhead, as this would be pyramiding the charges; but where comparative costs of the economics are desired, then the indirect or non-productive labor should be charged with all the other component parts of the overhead. In other words, the difference in labor costs, as obtained by subtracting the cost of labor used with the new method or device from that required for the old method or device must be loaded with its proper share of the burden of overhead applied to both productive and non-productive labor in the correct relative proportion."

The four following constants are used in determining the debit items:

A = percentage allowance on investment = 6 per cent;
B = percentage of investment to provide for insurance, taxes, etc. = 4 per cent;
C = percentage of investment to provide for upkeep = 10 per cent;
D = percentage of investment to provide for depreciation and obsolescence = 100 per cent; and
E = total percentage allowance = 120 per cent.

The three following items are assigned to the credit side of the estimate:

S = yearly saving in direct labor cost, in dollars;
T = yearly saving in direct labor, burden, and material, in dollars; and
U = yearly saving or earning through increased production, in dollars.

Other items that enter into the computations are:

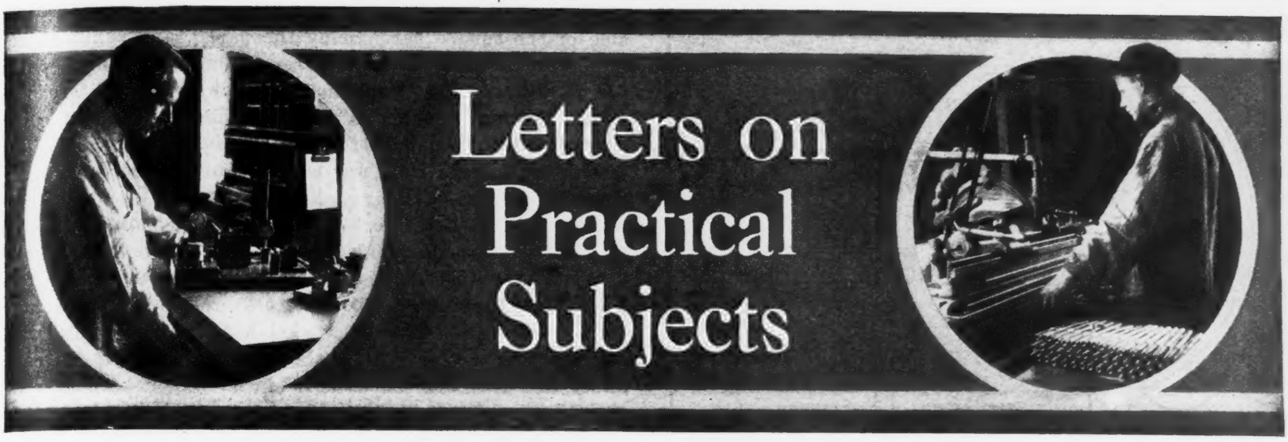
I = estimated initial cost of tools;
X = maximum investment justified;
Y = yearly profit from operation of tools; and
Z = yearly cost of maintaining tools in operating condition.

The required values are obtained from the formulas:

$$X = \frac{S + T + U}{1.20} \qquad Y = (S + T + U) - Z$$

$$Z = I \times 1.20$$

It will be noticed that in this case we have established fixed rates of percentage allowances; these, of course, may be altered to suit existing conditions. For instance, 100 per cent is allowed for item D, which means that the tool must pay for itself in one year. This seems to be the best all-around plan, although it may not fit every case. As an example of the application of the formulas, let us assume that the production of a certain part costs, in direct labor, \$2874 annually, but that by a change of methods and the use of proposed new special tools the work can be done for \$2499, or at a saving in direct labor of \$375. Now let us assume that T is 200 per cent of the saving in direct labor cost, thus making the item T = \$750. Then there is a saving of \$300 resulting from increased production. It is also estimated that the initial cost of the special tools will be \$750. Therefore we have S = \$375; T = \$750; U = \$300; I = \$750; $X = \frac{1425}{1.20}$ = \$1187.50; Z = \$900; and Y = \$525.



USING THE UNWORN PORTION OF A LEAD-SCREW

While most engine lathes have lead-screws that extend nearly the full length of the lathe bed, the right-hand portion generally receives comparatively little use, and as a result remains accurate long after the portion nearest the headstock shows appreciable wear. Thus the unused portion may be sufficiently accurate to meet the requirements of an exacting job for which the used part could not possibly be employed.

After having located the section of the lead-screw that is accurate enough for the threading job to be performed, some means must be provided for utilizing it. The equipment employed for this purpose in one instance is shown in Fig. 1. The work consisted of cutting the threads in some laps that were to be used in gage work and that were required to be very accurate. The laps, one of which is shown at *L*, Fig. 1, were about 3 inches in length and of different diameters ranging from 3/16 to 2 1/4 inches. The spindle extension *A* was driven from the headstock spindle at one end and supported at the other end by a bronze box held in a regular steadyrest. The right-hand end of the special spindle was bored to receive the standard headstock center *B* and provided with a threaded nose for carrying a driving plate *C*. The extension spindle *A* is of a length that brings the work at the proper position with respect to the accurate portion of the lathe lead-screw.

The major problem in equipping the lathe for this job was the boring of the steadyrest bearing and the proper aligning of the spindle with the carriage ways. A special boring-bar *D*, Fig. 2, was used for this job. This bar was approximately 2 1/8 inches in diameter, and was ground to insure straightness. A 3/8-inch keyway was cut at the point where the work of boring the steadyrest was to be done. A cutter-head using two cutters in order to balance the cutting strain was used on the boring-bar. This cutter-head was a sliding fit on the bar, and was provided with a keyway that matched the one in the boring-bar. A key inserted in the keyway served to prevent the cutter-head from rotating on the bar. A straight bar *E* having a roller that pressed again the end of the cutter-head was placed in the carriage toolpost. The steadyrest bearing was bored out to size by the two cutters, the cutter-head being fed along the boring-bar by engaging the carriage feed.

The boring-bar was, of course, tested for alignment with the center line of the lathe in both the vertical and horizontal planes before the boring operation was performed. The necessary corrections were made by adjusting the footstock. The regular jaws of the steadyrest were removed, and a light cut taken on the main steadyrest casting in order to provide an adequate cylindrical support for the bronze bearing. This was done with the object of providing a bearing that closely approached the headstock with respect to accuracy and rigidity. The driving end of the spindle was made to fit the taper socket of the main spindle by which it was driven.

Springfield, Vt. O. S. MARSHALL

BORING A LARGE STEEL FORGING

A short time ago the writer was asked to submit a bid on a job of boring out two cylinders like the one shown at *A*. These cylinders were to be bored from solid steel forgings which had been rough-turned to an outside diameter of 18 inches. As no work of this kind had previously been attempted, there were no figures on which to base an estimate of the cost, but after carefully considering the job, the writer estimated that 100 hours machine work would be required for each forging, and was rather surprised on being awarded the contract.

The machine used was a 54-inch Pond lathe, having spindle speeds of 16, 25, and 40 revolutions per minute, and feeds of 1/64 and 1/32 inch per revolution. After chucking and centering the forging in the back-rest, a 1 13/16-inch hole, 11 inches deep, was drilled with a portable electric drill, using the tailstock wheel to feed the drill. Next a 3-inch round bar carrying a 3 1/4-inch double-ended high-

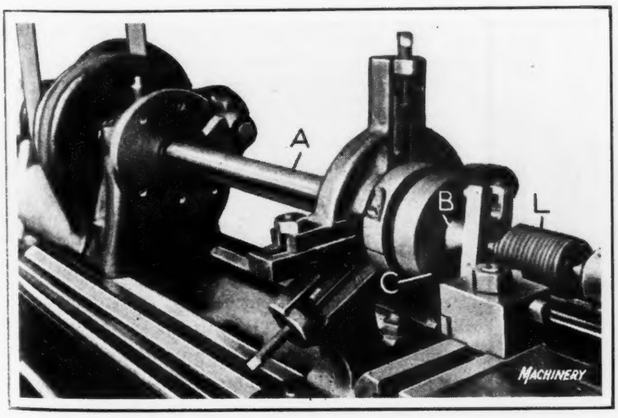


Fig. 1. Lathe equipped with Extension Spindle for Threading

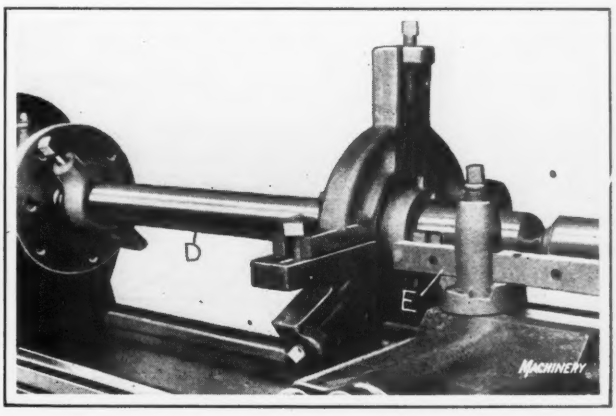
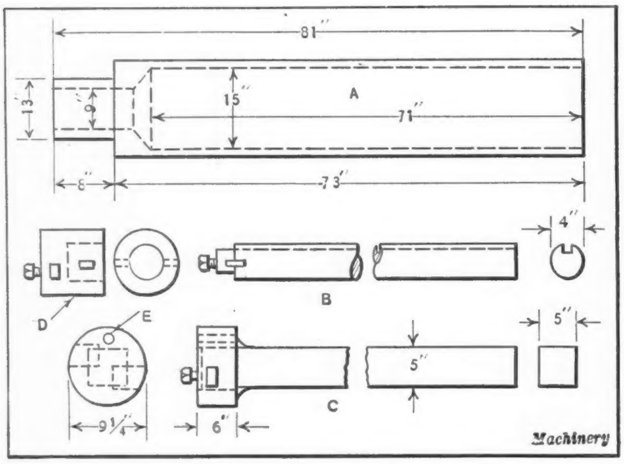


Fig. 2. Method of boring Bronze Bearing for Extension Spindle



(A) Cylinder bored out from a Solid Steel Forging; (B) and (C) Boring-bars used in boring out Cylinder

speed cutter in a slot at one end was used to counterbore the drilled hole. After counterboring, the electric drill was used to increase the depth of the 1 13/16-inch hole, after which the boring-bar with the 3 1/4-inch cutter was again used. By alternately drilling and boring in this manner, a hole 3 1/4 inches in diameter was bored to a depth of 60 inches. The drill and boring cutter were lubricated with old automobile crankcase oil by means of an oil gun.

By using larger cutters in the boring-bar, the hole was enlarged to a diameter of 4 1/4 inches, after which a larger boring-bar *B* made from a piece of cold-rolled shafting 4 inches in diameter and 8 feet long, was used. A 3/8-inch keyway was milled the full length of this bar, and a piece of 1/8-inch iron pipe driven into the milled slot. This pipe was connected with an oil container which served to keep the cutters flooded with oil. By using double-ended cutters in this boring-bar, the hole was enlarged to a diameter of 7 inches, after which a larger head *D* was fitted to the end of the bar. The head *D* was made from a piece of 6 3/8-inch round stock, bored out to fit over the end of the bar, and was held in place by a cross-key in the slot previously used for the cutters. Two slots were cut in the sides of head *D* to receive cutters 1 inch square. With two sets of cutters in the boring head, the hole was enlarged to a diameter of 9 1/2 inches.

In looking around the forge shop, a steel billet 5 inches square and 8 feet long was found, which served as the shank for the boring-bar shown at *C*. To the end of this square bar was welded a piece of scrap shafting, 9 1/4 inches in diameter by 6 inches long. A hole 5 inches square was cut in the 9 1/2-inch scrap piece, so that both ends could be welded to the square bar. Two slots were cut in the head of the boring-bar to receive cutters, 3/4 inch by 1 1/2 inches in cross-section. A hole *E* was drilled through the head to receive the end of the oil-pipe which was laid along the top side of the square bar. Using the bar *C*, and running the lathe spindle at a speed of 16 revolutions per minute, with a feed of 1/32 inch, the diameter of the bore was increased 1 inch per cut. Care was taken to have the tools at each side of the head remove the same amount of stock. With this boring-bar the hole was enlarged to the required diameter of 15 inches.

After boring the large hole to the required diameter, the forging was turned end for end, and the smaller 9-inch hole bored to meet the larger one, using the same method as for boring the larger hole. To reduce vibration in the boring-bar caused by heavy cuts, a steel bar, 2 by 4 inches, was bolted across the rear end of the lathe carriage. In the center of this bar, was placed a 7/8-inch eyebolt. A ring was slipped over the end of the boring-bar and connected with the eyebolt by means of a turnbuckle. As the highest spindle speed of the lathe was 40 revolutions per minute, time was saved by using the electric drill as described. By using the methods described, and employing tools and material that were on hand, the work was completed at a profit within the estimated time.

Portland, Me. H. K. GRIGGS

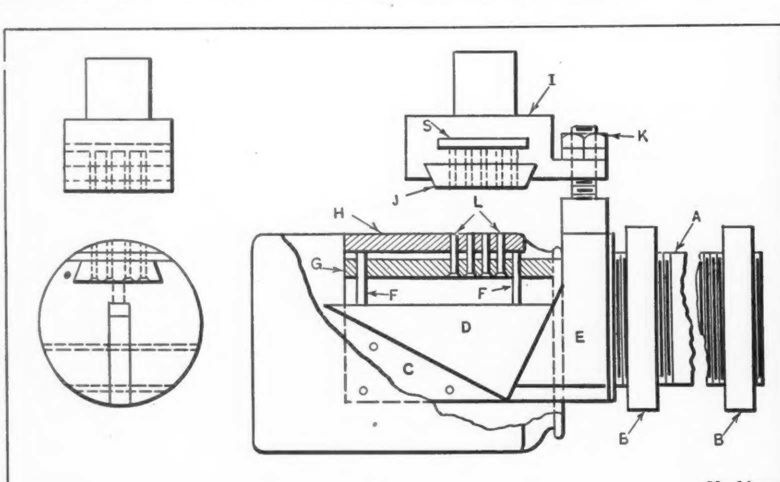
SAVING STOCK IN MAKING BLANKING DIES

Substantial economies can often be effected in making blanking dies by reducing the amount of tool steel scrap to a minimum. With the method to be described, a bar of tool steel, approximately equal to the diameter of the bore in the die, is saved to be used in making smaller dies or other parts. Obviously, on a large die this saving is a considerable item.

The bar of tool steel is held in an ordinary chuck, and first turned to the diameter of the outside of the die, leaving the usual allowance for grinding. The next procedure is to space off the length of the die and then feed an ordinary cutting-off tool straight into the stock to a diameter approximately 1/16 inch larger than the required bore of the die. A radius cutting-off tool, mounted with the cutting point perpendicular to the end of the bar and located the proper distance from the center of the bar so as to cut to a diameter slightly less than that of the bore, is next fed into the bar until it intersects the previous spacing cut. When this cut is reached, the die falls off.

This procedure can be repeated for any number of dies, and the bar that is left used as already explained. Dies 1 1/2 inches thick have been successfully cut off by this method in a LeBlond 13-inch heavy-duty lathe equipped with a turret toolpost. The two cutting-off tools were held in this tool-post and alternately indexed into position.

Madison, Wis. CHARLES F. BOUCHARD



Die for piercing Strainer Holes in Coffee Percolator

DIE FOR PIERCING STRAINER HOLES

The die shown in the accompanying illustration was developed for piercing the strainer holes in an aluminum coffee percolator. It is necessary that the punches be located inside the shell so that any burrs that might be produced would be on the outside where they would not interfere with the cleaning of the percolator.

The piercing die is constructed for use on a horn type of press. The shank *A* of the horn in which the punches *L* are fitted is made a tight push fit in the stationary member of the press. The nuts *B* are provided to permit alignment of the punches with the die member *J*. The wedge *C* is secured to the horn by three 1/4-inch pins. The loose wedge *D*, when pushed forward by the cam *E*, raises

the pins *F* which cause the stripper plate *H* to rise and strip the shell from the punches *L*. The nuts *K* on the stem of the cam *E* permit this member to be so adjusted that the stripper plate *H* will be raised just above the ends of the punches when the ram of the press is at the top of its stroke. The punch-holding member *G* is fitted in a dovetailed groove in the horn of the press. The punches *L* are made of drill rod, and their heads are riveted over to prevent them from being pulled out of block *G*. The die member, which is dovetailed to receive the die *J*, has a slot at *S* which permits the slugs to work out of the die.

When the press ram descends, the cam *E* is lowered, and when the die *J* strikes the shell, pressure is exerted on the stripper *H* which, in turn, through the pins *F*, applies pressure to the loose wedge *D*, causing it to slide backward on the fixed wedge *C*. This causes the stripper plate *H* to be depressed so that the punches pass through the stock and enter the holes in die *J*. On the upward stroke the die-holder *I* raises the cam *E*, causing the shell to be stripped from the punches. The vibration of the press tends to cause the slugs to work out at either side of the holder *I* through slot *S*.

Navarre, Ohio G. R. CASTER

RIVET HEAD DIMENSIONS

In most text-books, the tables giving the dimensions of rivet heads do not include the smaller sized rivets, but generally begin with rivets 1/2 inch in diameter. Thus in order to find the diameter or height of head of a small rivet, it is necessary to employ a formula. In the accompanying table, are given the diameter and height of head for rivets from 1/8 up to 7/16 in diameter. The dimensions given in this table have been calculated by the commonly used formulas.

Albion, Mich. RALPH WILKINSON

SIZES FOR RIVET HEADS

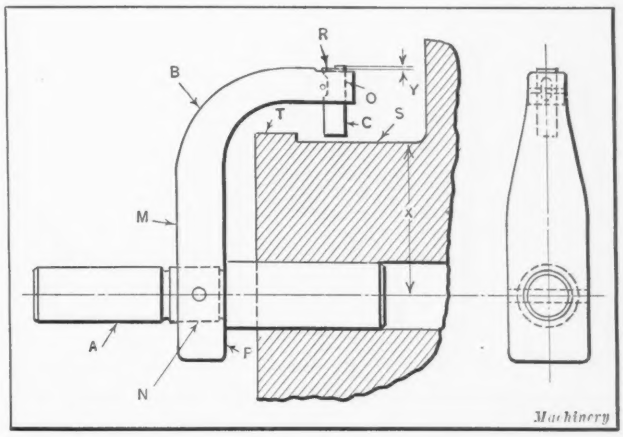
Diameter of Rivet, Inch	Diameter of Head, Inch		Height of Head, Inch	
	Round Head	Countersunk Head	Round Head	Countersunk Head
1/8	7/32	15/64	3/32	1/16
3/16	21/64	11/32	9/64	3/32
1/4	7/16	15/32	3/16	1/8
5/16	35/64	37/64	15/64	5/32
3/8	21/32	11/16	9/32	3/16
7/16	49/64	13/16	21/64	7/32

Machinery

GAGING DISTANCE FROM HOLE TO FINISHED SURFACE

In August MACHINERY, on page 987, is a description of a rigid "Go" and "Not Go" gage used to gage the distance between the center of a hole and a finished flat surface. The accompanying illustration shows a flush-pin type of gage which the writer believes has some advantages not found in the solid type of gage. The flush-pin gage consists of the plug and handle *A* of hardened and ground machine steel; the body *B*, which is a machine-steel forging; and the flush-pin *C*, with the tolerance step *Y*, which is a piece of drill rod that is hardened, ground, and lapped. As the tolerance *Y* is only 0.004 inch, considerable accuracy was required in performing the grinding operations on body *B*. After carburizing and before hardening, the body *B* was squared up to correct any distortion caused by the carburizing operation.

The hole *O* was lapped to a close sliding fit for the pin *C*. The face *M* was next ground, the body being held in a vise during the grinding operation. In order to grind surface *M* parallel with the pin *C*, a close-fitting plug was placed in the lapped hole *O* and an indicator employed to level up the body *B* before proceeding with the grinding operation. The



Flush-pin Gage for gaging Distance from Hole to Finished Surface

body *B* was next placed on a magnetic chuck, with the surface *M* flat on the face of the chuck for grinding surface *P* parallel with *M*. A plug was then inserted in the lapped hole *O* and secured in a vertical position in a V-block; the plug was used to hold the gage while grinding the surface *R* square with the hole.

The final operation on body *B* was the grinding of hole *N*. The faceplate of the grinder was first trued up, after which the body was clamped in place, with the surface *M* against two parallels on the faceplate and the hole *N* trued up with the center of the spindle. With the work in this position, it was an easy matter to grind hole *N* to give a tight fit on plug *A*. One of the advantages of a gage of the type described is that it can be used to gage surfaces like the one at *S*, as the flush-pin can be raised to permit the gage to be passed over a shoulder such as shown at *T*. There is also no danger of the operator springing or bending the body of a gage of this type.

Oakland, N. J. ALFRED T. GREGORY

TOOL LAY-OUT FOR TURRET LATHE

The turret lathe tool lay-outs shown in Figs. 1 and 2 are employed in machining the part *A*. For the first operation, the part is gripped in a three-jaw chuck. A cross-sectional view of one of the chuck jaws is shown at *B*, Fig. 2. In the spindle of the machine is a bushing *C* which acts as a support for the pilot of the boring-bars. The first operation consists of boring the two holes *Y* and *Z* and facing the end of the work while the surface *X* is being turned. The hole *Z* is first drilled with the drill shown at *D* which is held in a holder *E* mounted on the turret *F* of the machine.

After hole *Z* is drilled the turret is withdrawn and indexed to bring the boring-bar *G* into the operating position, following which the small hole is bored out by cutter *H* while hole *Y* is bored by cutter *J*. During the latter operation, the cutter *K* turns surface *X*. Cutter *K* is held in a supporting stem *L* which, in turn, is mounted in the holder

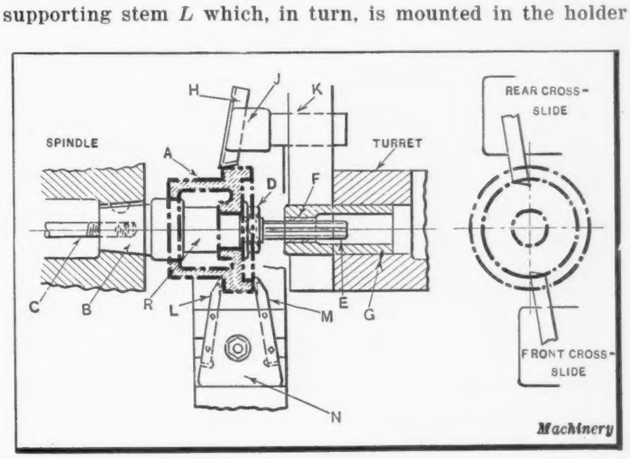


Fig. 1. Turret Lathe Tool Lay-out for Final Operations on Part shown at A

M attached to the face *F* of the turret. After the cutters *H*, *J*, and *K* have completed their operations, the turret is again indexed to bring the boring-bar *N* and cutters *P* and *Q* into position for finish-boring the holes *Z* and *Y*. While the boring operations are being performed, the cutter *R* finish-turns the surface *X*, following which a reamer *S* in a floating tool-holder *T* is employed to ream the small hole *Z*.

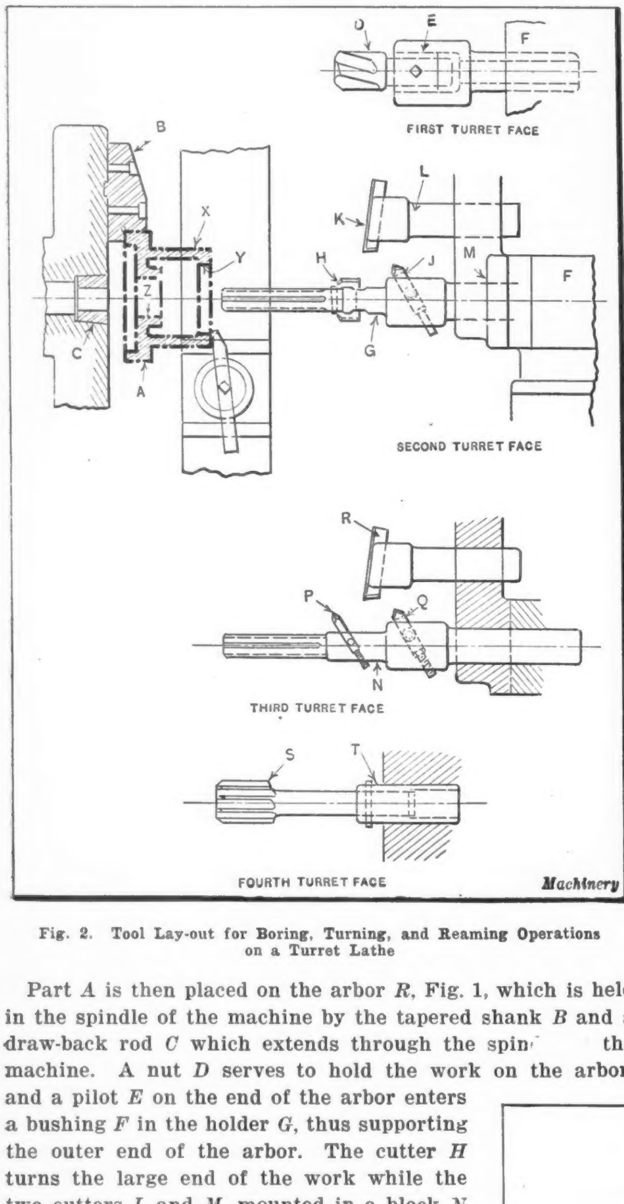


Fig. 2. Tool Lay-out for Boring, Turning, and Reaming Operations on a Turret Lathe

Part *A* is then placed on the arbor *R*, Fig. 1, which is held in the spindle of the machine by the tapered shank *B* and a draw-back rod *C* which extends through the spin[illegible] the machine. A nut *D* serves to hold the work on the arbor, and a pilot *E* on the end of the arbor enters a bushing *F* in the holder *G*, thus supporting the outer end of the arbor. The cutter *H* turns the large end of the work while the two cutters *L* and *M*, mounted in a block *N* attached to the cross-slide of the machine, rough-face the work. After these operations, the turret is withdrawn and indexed to bring a finishing set of tools consisting of a turning cutter similar to the one shown at *H* and two facing cutters similar to those shown at *L* and *M* into the operating position.

Holyoke, Mass. FRANK H. MAYOH

JACK TESTING MACHINE

The testing machine shown in Figs. 1 and 2 is used to test jacks of the mechanical ratchet and hydraulic types after they have been repaired. It is important that heavy-duty jacks be kept in a safe and efficient condition, as many serious injuries have resulted in car and locomotive shops through failure to observe this precaution. By requiring all jacks to pass a satisfactory test in the device shown after they have been repaired, the danger of an unsafe jack finding its way into the shop is greatly reduced.

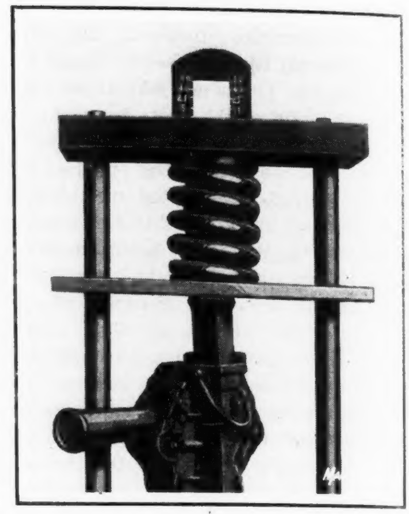


Fig. 1. Jack Testing Device

The method of testing a jack is shown quite clearly in Fig. 1. The base of the jack to be tested is placed on the cross-piece *A*, Fig. 2, and the head of the jack under the plate *B*, after which the jack is made to lift or raise the plate *B* until the pressure registered on the scale *C* is considerably greater than that which the jack will ordinarily be required to withstand. The base *A* is bolted to the floor to prevent the device from being tipped over when operating the jack. The method of using channel iron and iron plates in constructing the testing device is clearly shown in Fig. 2 and should need no explanation. The expansion spring *D* is made from spring steel, and is 9 inches in diameter by 12 inches long.

Chattanooga, Tenn. H. H. HENSON

* * *

NEW PROCESS FOR MAKING ILLUMINATING GAS

A new process for the manufacture of non-poisonous heating and illuminating gas which is said to have twice the heat and candlepower of the ordinary domestic gas now in use and which can be manufactured at a cost of less than half the cost of ordinary gas, is claimed to have been developed by Orestes U. Bean, inventor of the Bunsen furnace. The Bean process differs, it is stated, from processes hitherto used for manufacturing illuminating gas by eliminating the low heat-value carbon-oxygen combinations which form a large percentage of ordinary gas. The Bean process has been developed in a commercial plant at West Babylon, N. Y., during the last three years, and it is believed that the development of this process will prove of considerable importance in the industrial field, as well as in the domestic use of gas.

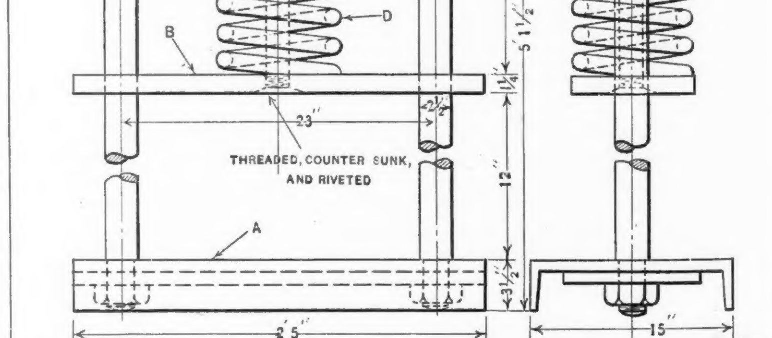
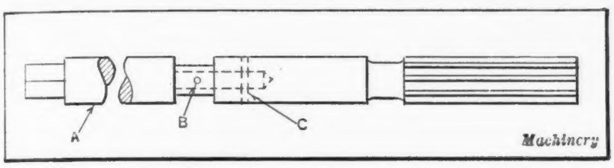


Fig. 2. Details of Testing Device shown in Fig. 1

Shop and Drafting-room Kinks

REAMER EXTENSION FOR LINE-REAMING

A simple method of fitting an extension *A* to an ordinary reamer, so that it can be used for reaming two holes in accurate alignment is shown in the accompanying illustration. The extension is fitted to the reamer by first drilling a hole in the reamer shank to receive the turned down end of the extension. The turned end should be a press fit in the reamer shank. The diameter of the extension should be large enough to permit grinding it to size after assembling.



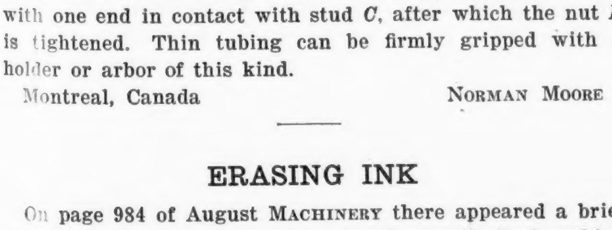
Reamer fitted with Extension for Use in Line-reaming

Two pins *B* and *C*, at right angles to each other, prevent the extension from turning in the reamer or from becoming loose. The end of the extension is provided with a square portion to permit turning the tool with a wrench. The extension member may be made of tool steel and heat-treated, or it may be made from machine steel and used without heat-treatment, as the nature of the service may require.

Springfield, Vt. H. L. WHEELER

ARBOR FOR CUTTING RINGS FROM TUBING

A rigid arbor for holding brass tubing while it is being parted or cut up into rings, such as shown at *A* in the accompanying illustration, can be made very cheaply from a piece of plain round stock *B* that fits the bore of the tubing. The clamping device consists of a stud *C*, two washers *D*, nut *E*, and pin *F*. A hole is drilled through the center of the arbor *B* to receive the stud, and a drive fit hole is drilled for pin *F*. A space is left at the back of pin *F* to permit a lathe dog to be secured to the arbor.



Arbor for cutting Rings from Tubing

The tube to be cut up into rings is slipped on the arbor with one end in contact with stud *C*, after which the nut *E* is tightened. Thin tubing can be firmly gripped with a holder or arbor of this kind.

Montreal, Canada NORMAN MOORE

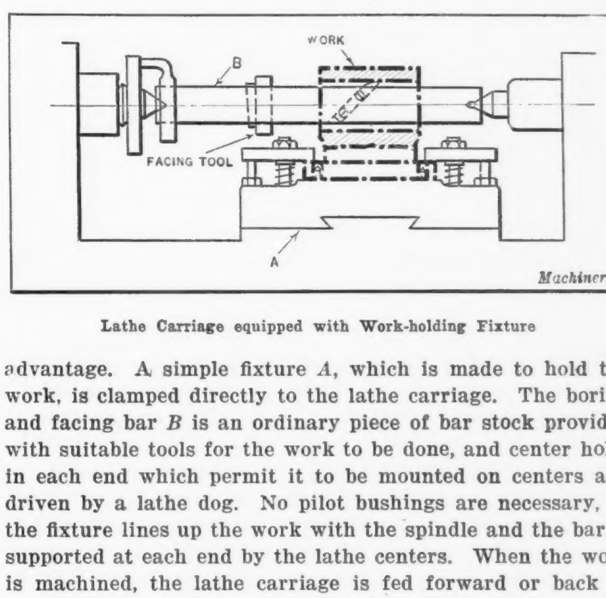
ERASING INK

On page 984 of August MACHINERY there appeared a brief article on the use of erasers. Another method of making erasures, which the writer has used with good results, is described in the following: To make a particularly neat erasure on tracing cloth, first clean off as much ink as practicable with the ordinary soft eraser—with or without the use of a shield. Then drop a pinch of tracing cloth powder on the spot, and rub it with a piece of soft cloth stretched tightly over the tip of the forefinger. This part of the work may also be done with the aid of a shield if preferred, but the shield should be an old, thin one.

When all the ink has disappeared, remove the shield and, with a piece of cloth wadded up tightly, rub briskly back and forth over the erased spot, using considerable pressure. This last process puts a gloss on the surface that will take ink perfectly and that will not later pick up dirt. This is particularly true of drawings made on the glossy side of the tracing cloth, where an erasure made in this manner cannot be detected even by reflected light. A smooth, hard surface—such as a celluloid triangle—slipped under the spot to be erased saves time and labor, and seems to give a better job. Tracing cloth powder that feels a bit gritty when rubbed between the fingers is the proper kind to use. The little extra time required to make an erasure in this way is justified by the better wearing quality of the result, if not by its neater appearance. F. M. W.

BORING AND FACING LARGE WORK IN A LATHE

When it is necessary to bore and face a quantity of parts that are too large or awkward to be mounted on the faceplate of a lathe, the method here illustrated can be used to



Lathe Carriage equipped with Work-holding Fixture

advantage. A simple fixture *A*, which is made to hold the work, is clamped directly to the lathe carriage. The boring and facing bar *B* is an ordinary piece of bar stock provided with suitable tools for the work to be done, and center holes in each end which permit it to be mounted on centers and driven by a lathe dog. No pilot bushings are necessary, as the fixture lines up the work with the spindle and the bar is supported at each end by the lathe centers. When the work is machined, the lathe carriage is fed forward or back as required, the amount of travel being determined by stops. Work of the kind referred to could, of course, be done on a horizontal boring mill, but many small shops are not equipped with this type of machine tool.

Woonsocket, R. I. N. E. BROWN

* * *

During the first six months of 1925 Russia purchased in the United States agricultural machinery valued at $3,415,-000, oil-well machinery valued at $690,000, and general industrial machinery and parts valued at $1,302,600. Practically all these purchases were made through the Amtorg Trading Corporation of New York. During 1924, general industrial machinery and parts were bought to a value of $1,358,000, oil-well machinery to the value of $679,000, and agricultural machinery to the value of $1,768,000. A great many small tools, especially twist drills, have also recently been shipped to Russia, one order comprising nearly 1,000,000 twist drills.

Questions and Answers

MILLING OPERATIONS ON ALUMINUM CASTING

R. C. B.—A lot of 100 aluminum castings like the one shown in Fig. 1 are required to be milled on the surfaces bearing finish marks. Will some reader of MACHINERY who has had experience in milling work of a similar nature describe suitable fixtures and tool equipment for this job?

ANSWERED BY S. W. BROWN, PAWTUCKET, R. I.

In Fig. 2 is shown an end view of the aluminum casting *A* clamped on a plate *B* which is bolted to the milling machine table. A pair of side milling cutters *C*, spaced to straddle-mill the 1/8-inch flange is shown in the working position. It will be noted that one cutter is of larger diameter than the other. A fast speed and feed should be employed and lard oil used as a lubricant. If an attempt is made to mill only one side of the flange at a time, very light cuts must be taken in order to prevent the metal from being bent or sprung by the sidewise pressure exerted by the cutters.

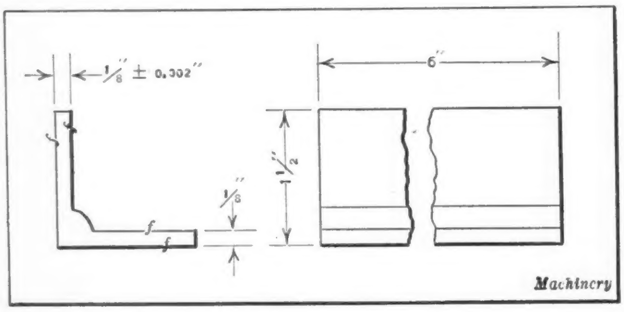


Fig. 1. Aluminum Casting to be machined

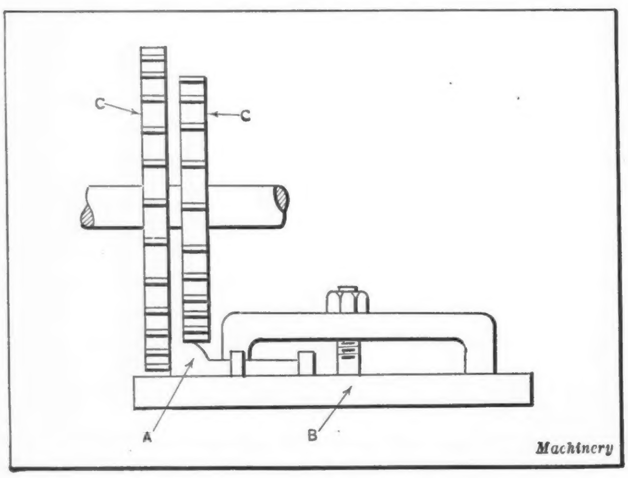


Fig. 2. Straddle-milling Part shown in Fig. 1

GLUE FOR ATTACHING MICA TO STEEL

R. H. C.—Can any reader of MACHINERY give the composition of a glue or cement for attaching sheet mica 0.010 to 0.015 inch thick to cold-rolled sheet steel or cast-iron plate? All the common glues, ordinary shellac, and button shellac have been tried without success.

ANSWERED BY A. EYLES, MANCHESTER, ENGLAND

As various glues and shellacs have been tried without success, the writer believes that poorly prepared materials, spoiled glue, or incorrect methods have been employed. There are various glues and adhesives that will give good results when used to attach mica to steel or iron. The methods outlined in the following are among those most generally employed.

In preparing glue, it should be allowed to stand overnight in clean, cold water, which causes it to swell greatly. The water should then be poured off, and the glue dissolved in hot water. The glue receptacle should not be heated by contact with the fire, as lumps of partially dissolved material may adhere to the bottom and become charred. Instead, the vessel containing the glue should be placed inside a larger vessel containing hot water. Prolonged heating injures the adhesive qualities of glue and increases its tendency to foam. A glue that foams badly is of little use for attaching sheet mica to sheet steel, as the air bubbles destroy its adhesive property.

A mixture of gum and calomel forms one of the best adhesives for attaching mica to steel. It is prepared by putting the very best pure gum arabic into a small quantity of water, and allowing the mixture to stand overnight, after which it should have the consistency of treacle. Calomel (mercurous chloride or subchloride of mercury) is then added in sufficient quantity to form a sticky mass, which should be well mixed on a perfectly clean surface with a spatula. No more of the adhesive should be mixed than is required for immediate use. Although this adhesive hardens within a few hours, it is best not to disturb parts that have been joined by it for a day or two.

Another satisfactory glue is made by putting two ounces of isinglass into a bottle and adding a half pint of mentholated spirits. The bottle should be placed in the sun or in a warm room until the isinglass is dissolved. This process may require several days, during which time the bottle should be shaken frequently. When the isinglass is in solution, the liquid should be strained through a fine piece of muslin.

A gum and plaster-of-paris cement having good adhesive qualities is made by dissolving 1 1/2 ounces of gum acacia in a half pint of boiling water and adding sufficient plaster-of-paris to form a paste. The materials to which the cement is applied should be pressed together as tightly as possible, in order to squeeze out the air bubbles.

A general-purpose glue may be made by mixing twenty parts of boiled linseed oil, twenty parts of Flemish glue, fifteen parts of hydrated lime, five parts of alum, five parts of acetic acid, and five parts of turpentine. In mixing the materials, the glue should first be dissolved in the acetic acid, after which the lime is added, then the hydrated lime, and finally the turpentine and the boiled linseed oil. The parts thus mixed are rubbed, ground, or stirred until they form a homogeneous paste, and then placed in a tightly closed flask. This adhesive can be used the same as any ordinary glue.

Litharge, lead, and varnish can be used to form a good adhesive by mixing two parts of litharge and one part of white lead, and working them into a pasty condition by using three parts of boiled linseed oil and one part of copal varnish.

Borax and casein glue can be made by dissolving one part of borax in nine parts of clean water. When the borax is completely dissolved, three parts of casein are added and the mixture stirred thoroughly until it forms a thick fluid. It should be remembered that any glue or adhesive employed to attach mica to sheet steel or cast iron must be allowed to dry for a longer period than when used to join wood and other substances of a more porous nature.

A BASIC ALLOWANCE AND TOLERANCE SYSTEM

By W. L. HINDMAN

The August number of MACHINERY contained an article entitled "A Basic Allowance and Tolerance System." This article, which begins on page 933, is descriptive of a "uni-bilateral" system which has been developed by the writer. Certain comments on this system by John Gaillard appeared in the October number (see page 93). My reply is presented to the readers of MACHINERY to avoid any misunderstanding of the uni-bilateral system.

The fourteenth paragraph of Mr. Gaillard's article is as follows: "According to a statement made in the previous article, one of the largest reamer manufacturers in the United States furnishes his reamers within limits that have, for a certain range of diameters, a definite fixed position with regard to the nominal size. For example, for reamers from 1/2 inch to 12 inches in diameter, these limits are mentioned as being nominal size plus 0.0005 inch, and nominal size plus 0.0008 inch."

The following quotation is from my article (see page 934, August MACHINERY): "The tolerance range of standard reamers, as furnished by one of the largest reamer manufacturers in the United States, varies from + 0.0001 to + 0.0004 inch for reamers up to 1/2 inch, and from + 0.0005 to + 0.0008 inch for reamers up to 12 inches in diameter."

Mr. Gaillard develops reamer sizes for a 1-inch reamer, using plus 0.0008 inch as a foundation, in an attempt to show that the one-third and two-thirds division (or 1 to 2 ratio) of the tolerance to the nominal size is not satisfactory. Since the plus 0.0008 inch (for the tolerance) has no relation to a 1-inch reamer, it being applicable only to sizes in the 12-inch group, Mr. Gaillard's conclusions are erroneous.

In my article only the two extremes (with three intermediate steps omitted for the sake of brevity) of the tolerance range of standard reamers were given in order to show to the advocates of the pure bilateral system that, through a careful analysis, it had been found that a 16 2/3 per cent reduction can safely be made from the plus tolerance and added to the minus tolerance thereby adding 16 2/3 per cent to the life of reamers (as well as broaches) without changing the value of the tolerance.

The writer also endeavored to show to the advocates of the unilateral tolerances, where all the tolerance is below the nominal size, that a plus tolerance is essential in order to use a new reamer without first honing it to a size slightly under the nominal size. Since the uni-bilateral system is based more on manufacturing than on drafting-room practice, all standard reamers ground to a tolerance range of + 0.0001 to + 0.0004 are actually used in practice for a rather wide range of production tolerances.

Mr. Gaillard says: "Inequality between the two parts of the tolerance on both sides of the basic size line, as a matter of principle, is no novelty; it is inherent, for example, in the British 'Newall system' of tolerances, in which, however, the larger part of the tolerance is given as a plus variation, and the smaller one as a minus variation, the inverse of the method proposed."

This is conceded for all systems except the uni-bilateral system. The British "Newall system" is no novelty and cannot be compared but rather contrasted to the uni-bilateral system, since there is no fixed relation or ratio of the plus and minus tolerance to the nominal size. It starts out with a pure bilateral form, or 1 to 1 ratio, for both classes of fits, but changes more or less throughout the succeeding ratios rather erratically as follows:

Class A—1 to 1 : 2 1/2 to 1 : 3 1/2 to 1 : 2 to 1 : 2 to 1 : 2 to 1

Class B—1 to 1: 1.4 to 1 : 2 to 1 : 1.7 to 1 : 2.1 to 1 : 2.4 to 1

(See MACHINERY'S HANDBOOK, sixth edition, page 978.)

Further proof of the practical value of the uni-bilateral ratio (1 to 2) was obtained from a recent investigation made of tolerances used by 110 leading manufacturing firms in the United States (including practically all the automotive manufacturers). The result showed an average tolerance applied in a 1 to 2, or a uni-bilateral ratio, to the nominal size.

Mr. Gaillard says, in paragraph 3, "It may be emphasized here that interchangeability is guaranteed in a greater number of cases of fit with the unilateral than with the bilateral system." (The unilateral system, in which all of the tolerance is above the nominal size, is later indicated as the one being considered). Since guaranteed interchangeability, as here referred to, evidently includes the unibilateral system as well as the bilateral system and all modifications of it, and also the unilateral system in which all of the tolerance is below the nominal size, the writer questions this statement and offers substantial proof that it holds true only on paper and not in actual, commercial practice. In the analysis, previously referred to, of tolerances used by 110 leading manufacturing firms, more unilateral (with tolerance below the nominal size), uni-bilateral, bilateral, and erratic modifications of the bilateral tolerances are used than any other form.

Invariably the argument advanced in favor of the unilateral system, in which all of the tolerance is above the nominal size, is "a constant or guaranteed minimum allowance," but nothing is said in regard to the variable maximum allowance. Any system that stands for maximum ease of control of only one out of two of these major items creates an attitude of indifference to the other which, at least, is of equal importance. In fact, many cases can be cited where the maximum allowance is more important than the minimum allowance, and the writer personally knows of serious mishaps occurring through the specified maximum allowance being exceeded.

The author has previously explained how the uni-bilateral system is adapted to special holes, and has described the legitimate reasons for special holes (see August MACHINERY, page 937). The same process is used, in nearly a duplicate manner, to handle satisfactorily the conditions cited in paragraph 7 of Mr. Gaillard's comments, which should properly be called a mistake made in the first assignment of tolerances. A broad and exact interpretation of the uni-bilateral system is that it is flexible enough to identify and properly classify any tolerance, irrespective of its size or location.

The author fully realizes the importance of minimum allowances or clearances as shown in the diagram at *A* and *B* (page 93, October MACHINERY) and did not intend that the uni-bilateral system would be applied as shown at *D* (same diagram) where a constant minimum clearance is required.

The uni-bilateral identification for diagram *D* is 1.001 $\begin{smallmatrix}+0.0010\\-0.0020\end{smallmatrix}$ (A3F — 0.0010) for the hole and 0.9975 $\begin{smallmatrix}+0.0010\\-0.0010\end{smallmatrix}$ (A3F — 0.0010) for the shaft, assuming that a 1.0010-inch reamer is to be used. For a 1-inch or standard reamer, the identification for the hole and shaft becomes: 1.000 $\begin{smallmatrix}+0.0020\\-0.0010^*\end{smallmatrix}$ (A3F — 0.0010) and 0.9975 $\begin{smallmatrix}+0.0010\\-0.0010^*\end{smallmatrix}$ (A3F — 0.0010), respectively. (* indicates a "hybrid" mean size as the reamer size in order to avoid a special reamer.) The figure — 0.0010 in the symbol shows that a standard application is not being used. In other words, the mistake is not buried, but has to be accounted for in the record of fits. But this special condition is automatically dropped when a new design is made or a modification is made calling for different parts which are not interchangeable with the first parts, quite independently of any tolerance. This evolution of design is constantly taking place with every product. The symbol then would become (A3F) which is the standard uni-bilateral identification.

In regard to paragraphs 11 and 12 (see comments in October MACHINERY), it may be interesting to the readers of MACHINERY to know that C. E. Johansson (inventor of the Johansson gages), recently delivered a lecture (in Detroit) where he described his system for maximum economical production, and this system is the pure bilateral system.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, October 14

BUSINESS in the metal-working industries remains slow, and few branches of engineering have shown distinct changes either for better or worse during the last two or three months. The general attitude is that while business continues to materialize even at the present rate, every month sees a slight strengthening of the position. Such important branches as shipbuilding and marine engineering generally have considerable cause for anxiety, but other sections of the engineering industry, notably the automobile industry, show an advantage that helps toward balancing the general position.

The Machine Tool Industry

The machine tool industry reflects the general engineering position, and reports from machine tool centers show wide differences in the amount of new business being obtained. In Yorkshire, makers of standard machines have rather more work in hand. In this district also manufacturers of surface grinding machines and radial drilling machines are busy, but there is a slacking off in the demand for punching and shearing machines.

In the Birmingham district is to be found by far the largest proportion of machine tool makers who are really busy; not only is the interest of the automobile manufacturers in machine tools maintained with a tendency to increase, but several important makers have been successful in securing very good colonial orders. A large volume of inquiries for special machine tools is in evidence, and the estimating and designing departments are being kept exceptionally busy.

Machine tool makers in the Manchester area are not, in general, making a great deal of headway. Firms appear to be active for weeks following up promising inquiries from overseas, only to experience subsequent weeks of extreme slackness in inquiry. Under such conditions, together with only a modicum of actual work going through the shops, it is difficult to make plans for the future. Manchester, of all the machine tool centers, shows the least hopeful outlook. The Glasgow area, which had the longest slump experienced by any district, has a decidedly better outlook, and it is reported that there is now a strong disposition to buy new machines in preference to second-hand machine tools. The volume of work is in many cases insufficient to warrant running full time, but conditions are improving steadily, and the future is now viewed more hopefully than twelve months ago.

Overseas Trade in Machine Tools

August showed, more or less, a continuation of the general trend of overseas business in machine tools observed during the previous months of this year. The tonnage of exports was lower, as compared with July, but, on the other hand, the total value showed an increase that more than balanced the decrease in tonnage. The result was that the ton value of exports in August reached £126, as against £93 in July. The tonnage exported during August was 1051, and during July 1259. The corresponding total values were £131,900 and £116,769. Despite such variations, the general level of curves plotted for export tonnage and total values was maintained throughout the first eight months of the year. Peaks were reached during February and March, but were discounted by depressions during the summer months.

On the other hand, the tendency of machine tool imports has been progressively upward during the year. The tonnage for August was 495, as compared with 343 in July, the corresponding values being £72,359 and £51,611. It will be seen that the total value of imported machine tools is about one-half of those exported, and this proportion has been reached by steady growth from about one-quarter twelve months ago. The ton value of imported machine tools during August was £147, as compared with £151 in July.

General Engineering Field

Considering the remainder of the engineering field, business is progressing quietly, and the number of firms that are on full time and comfortably occupied with work is considerably greater than twelve to eighteen months ago. Constructional engineers are always the first to feel the benefits of any new undertakings or plant extensions, and recent improvement in this field is noteworthy. Several large bridge orders are in hand with North East Coast firms.

Locomotive builders in England are getting a very good proportion of overseas business, and the Sudan and Argentine are prominently represented in recent orders, which are benefiting the Leeds, Manchester, Darlington, and Glasgow districts. Locomotive orders are also expected from India for 1925-1926 railway programs.

Textile engineers are expecting a fairly productive winter. Russia has placed large orders, including one for £500,000, with textile machinery firms in the Manchester district, and Germany is beginning to buy on a larger scale. A large artificial silk plant is to be erected near Manchester at a cost of about £400,000.

The Automobile Industry

A temporary lull in the automobile trade has given makers a better opportunity to prepare the new season's production programs. In several cases, the preparations are in an advanced state, and a start on new schedules is expected during the next few weeks. Manufacturers are looking forward to another record season, and not only has much been done toward a recovery of several valuable overseas markets, but imported cars, particularly the cheaper varieties, must now meet serious competition from several quarters. The prices at which some of the light cars of British manufacture were sold last season were thought by many to be very near the limiting figure in value for money, but enterprise in creating a market by developing quantity production methods suited to this country has met with almost immediate success, so much so that further price reductions have been made possible in some of the best known makes of light cars.

Among the larger cars an interesting change has been made in the Knight engine fitted to Daimler cars; the valve sleeves which previously have been of a close-grained cast iron are now of steel, and consequently can be made much thinner in the wall, with a corresponding reduction in weight of the reciprocating parts.

Several car makers are increasing the number of pressed-steel parts used in their products. Where these replace castings or forgings, machining time is saved to a great extent, and provided the number required is sufficient, a condition which is now fulfilled in several instances, the cost of production is proportionately low. Such departures from established practice make an increased degree of standardization imperative, and makers now concentrate on one or two designs, where previously half a dozen or more were made. The same changes are taking place in the motorcycle and bicycle fields.

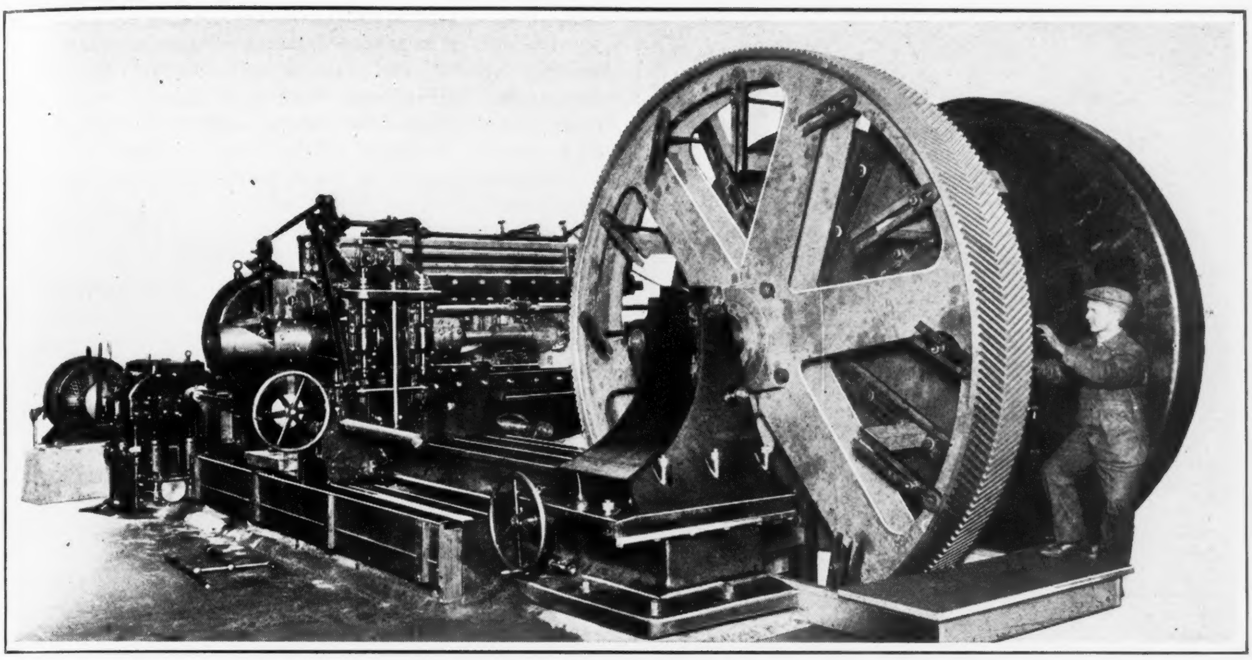


Fig. 1. Sykes Gear Generator which has a Capacity for Gears up to 18 Feet in Diameter

Generating Herringbone Gears

Sykes Process of Cutting Double Helical Gears of the Continuous Face Type, and Important Features of Generators Used

By W. E. SYKES, Consulting Engineer, Farrel Foundry & Machine Co.

HERRINGBONE or double helical gears which have continuous faces, without the slightest central clearance space for the cutters, are not new, but as very little has been published on this subject, the interesting method of cutting such gears will be described. Many users and others who have inspected gears of this kind have been at a loss to understand how it is possible to machine teeth, the right- and left-hand sections of which join at the center without any clearance space whatever for the cutters. It seems to the average mechanic to be impossible to machine a groove or tooth space which finishes abruptly in solid metal. Several instances are on record where those interested in this apparently impossible achievement have actually cut the gears to pieces in order to find a joint at the center of the teeth which they thought must exist. Like many apparently difficult machine shop operations, the production of the double-helical continuous tooth gears is very simple as it is done on the Sykes herringbone gear generators.

Three years ago the Farrel Foundry & Machine Co., Buffalo, N. Y., acquired the American and Canadian patents relating to the Sykes gear generating machines. At the time the patents were acquired, four gear-cutting machines of various sizes to cover the whole range of herringbone gear requirements were brought over from England. At the present time there are fifteen of these machines at the Buffalo plant, five of the largest size having a capacity for gears up to 18 feet in diameter; moreover to meet the demand for Sykes gear generating equipment, the whole range of gear-cutting machines has been placed on the market by the Farrel Foundry & Machine Co. Consequently, it is now possible to present to MACHINERY's readers a description of these interesting machines.

Cutters Used and their Action in Generating Continuous Herringbone Teeth

The cutters used in the Sykes gear generators are what are known as the pinion type; that is, they are like gears having teeth of involute contour, similar to the cutters used in the well-known Fellows gear shaping machines. For cutting single helical and double helical gears it is, of course, necessary to use helical cutters. Fig. 2 shows such a cutter, as used in the Sykes machines.

Fig. 3 shows diagrammatically the cutters in the process of cutting a gear blank, and also shows how the generation of the teeth proceeds. These cutters, as will be seen, are mounted on the gear-cutting machine with their end-cutting faces facing each other. Both cutters are mounted on one reciprocating carriage, so that, as they reciprocate to and fro, one cutter cuts when the reciprocation is in one direction, and the other cuts when the reciprocation is in the opposite direction. The construction of the machine insures that each cutter will end its stroke when its cutting edges are at the center of the blank face. It may thus be assumed that when one cutter reaches the end of its cutting stroke it leaves a burr or chip, and that the other cutter when completing its working stroke removes this burr and leaves another one.

This is actually what happens, but there is another interesting and very important feature which makes this method successful. The cutters not only reciprocate and twist during their reciprocation, so as to generate the helices, but they also slowly revolve in unison with the wheel blank, thus generating the tooth contours. This generating feature happens to result in finishing the apices of the teeth in a perfect manner. It can easily be understood that if one cutter merely removed the burr left by the other cutter, and in its turn left a burr, there would be some burr finally left. The generating action, however, of these cutters makes it impossible to leave any surplus metal, provided the machine is properly adjusted, because as each cutting tooth slowly revolves out of engagement with the tooth space it has cut, it cuts a chip which tapers off to an infinitesimal thickness, and this has the effect of cleaning out the corners perfectly.

Arrangement of Main Driving Mechanisms

One of the largest Sykes herringbone gear generators is shown in Fig. 1 and one of the smallest sizes in Figs. 4 and 5. This small size is representative of all the other sizes except the largest size, the only difference being that

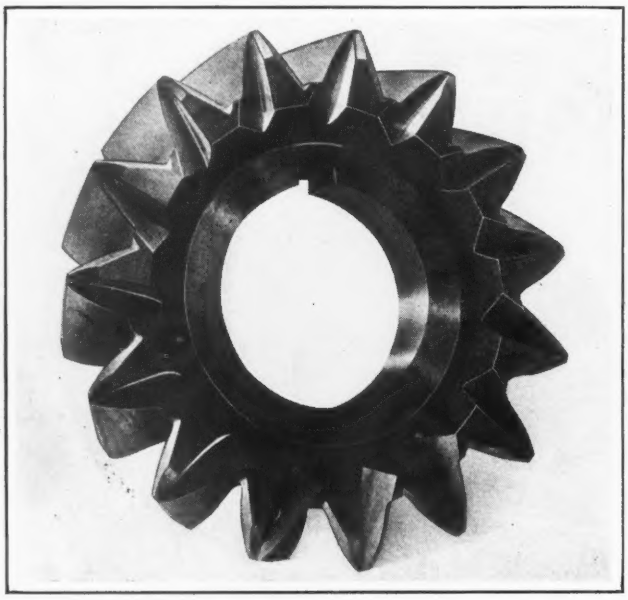


Fig. 2. One of the Cutters used for Helical Gears

machines now being constructed have a device for automatically controlling the tooth depth. Further reference to this device will be made later.

In the front view of the machine (Fig. 4) the cutters can be clearly seen. In the end and rear view (Fig. 5) the driving pulley is shown. This pulley is mounted on a shaft projecting from a four-speed gear-box which is made as a unit and mounted on one end of the machine. On the side of the gear-box opposite the driving pulley is the crank disk *A*, Fig. 6, which serves to reciprocate the main sliding carriage or ram that carries the cutter brackets. The four speeds provided by the gear-box can be changed selectively by suitable levers. All the gears in this gear-box have Sykes herringbone teeth, with the exception of a pair of bevel gears which rotate a vertical shaft extending through the top of the gear-box that serves to drive the generating feed mechanism. This vertical shaft connects through bevel gears and a safety clutch with another smaller four-speed gear-box which controls the rotating feed mechanism. This box has two power outlets, one of which connects to the cutter index worm-wheels *B* and *C*, Fig. 6, and the other to the main index worm-wheels. In the latter train of shaft and gear connections is interposed the only train of change-gears in the machine. These gears, which may be seen at the extreme left in Fig. 5, are for giving the correct ratio between the cutter-spindles and the main work-spindle, in order to cut any desired number of teeth. The driver change-gear is arranged to have the same number of teeth as there are in each cutter, and the driven change-gear, the number of teeth desired in the wheel blank to be operated on. Because of this arrangement, there are no complications in regard to the determination of the proper change-gear ratio to employ.

The crank disk *A*, Fig. 6, which is made integral with its shaft from a solid steel forging, carries an adjustable steel crankpin *D*, so that the exact stroke required is easily obtained. The crankpin drives the main reciprocating carriage through a square block engaging a vertical slot; thus the reciprocating carriage receives a pure harmonic motion, causing the cutters to decelerate uniformly from the middle to the end of the stroke. This is important because it is necessary that the cutters stop positively and without jar at the center of the face of the wheel blank.

Relieving and Twisting Motions of the Cutters

The cutters *E* and *F*, Fig. 6, are carried on casehardened steel spindles which are accurately ground and lapped. The bearings that carry these spindles are also of casehardened steel, and they are fitted accurately both on the journals and end faces. The spindles and bearings are lapped together to provide only a minimum running clearance and a perfect bearing surface. The brackets or heads carrying these cutter-spindles are each provided with flanged bases. These bases fit into guides formed in saddles which, in turn, fit in guides on the main reciprocating carriage.

The guides formed by the flanged bases of the cutter-head brackets and saddles already mentioned have their engaging surfaces at an angle with the axis of the cutter-spindles, as at *G* and *H*. This is part of the relieving mechanism which has the function of withdrawing each cutter from the wheel blank prior to the commencement of the return stroke. The angularity of the guides, combined with the longitudinal movement of the saddle, relative to the bracket, causes the latter to have a movement at right angles to the axis of the cutter-spindles. The correct amount of movement is governed by stops fixed at the end of the guides, and the movement is caused by the reciprocation of the main carriage in conjunction with a movement imparted by some rotating cams operating on cam rollers. It will be observed that, in the relieving motion, each cutter must have an independent movement, because while one cutter is withdrawing from the work, the other cutter must be approaching the work. Actually each cutter bracket is independent of the other one, except that each receives its reciprocating motion from the main reciprocating carriage.

Each cutter receives its twisting motion, necessary to follow the helical teeth, from helical guides which can be seen in the front view, Fig. 4. The cutter *F*, Fig. 6, farthest from the cutter index-gears and nearest the main index-wheel, is controlled, as far as its twisting and rotating movements are concerned, by the cutter index-gear *B*. This requires the shaft connecting this particular cutter-spindle with its helical guide *J* to pass through the other cutter-spindle and the other helical guide *K*. Therefore the spindle for cutter *E* is made hollow and is connected to the helical guide *K* nearest to it.

The helical guides are often referred to as cams, but actually they are screws; in action they are pulled through or pushed through fixed nuts which are a counterpart of the screws except of much shorter length. The screws have a long lead and they impart to the cutters exactly the same lead. In the small machine, Fig. 4, the lead of the guides is 21.765 inches; therefore, if the cutter could make a stroke equal to this lead it would turn exactly one revolution during one stroke. It is a fundamental principle that if two helical gears are to gear together with their axes parallel, the lead of the helices must be in direct proportion to the number of teeth. For instance, if a pinion having 20 teeth and a lead of 30 inches has to gear with a wheel having 40 teeth, the lead of this wheel must be 60 inches. It will be understood that the diameter of the cutter has no influence on the helix angle of the gears cut. Irrespective of any question of diameter, every wheel cut on a Sykes helical machine will have a lead in direct proportion to the lead of the helical movement of the cutters, the number of teeth in

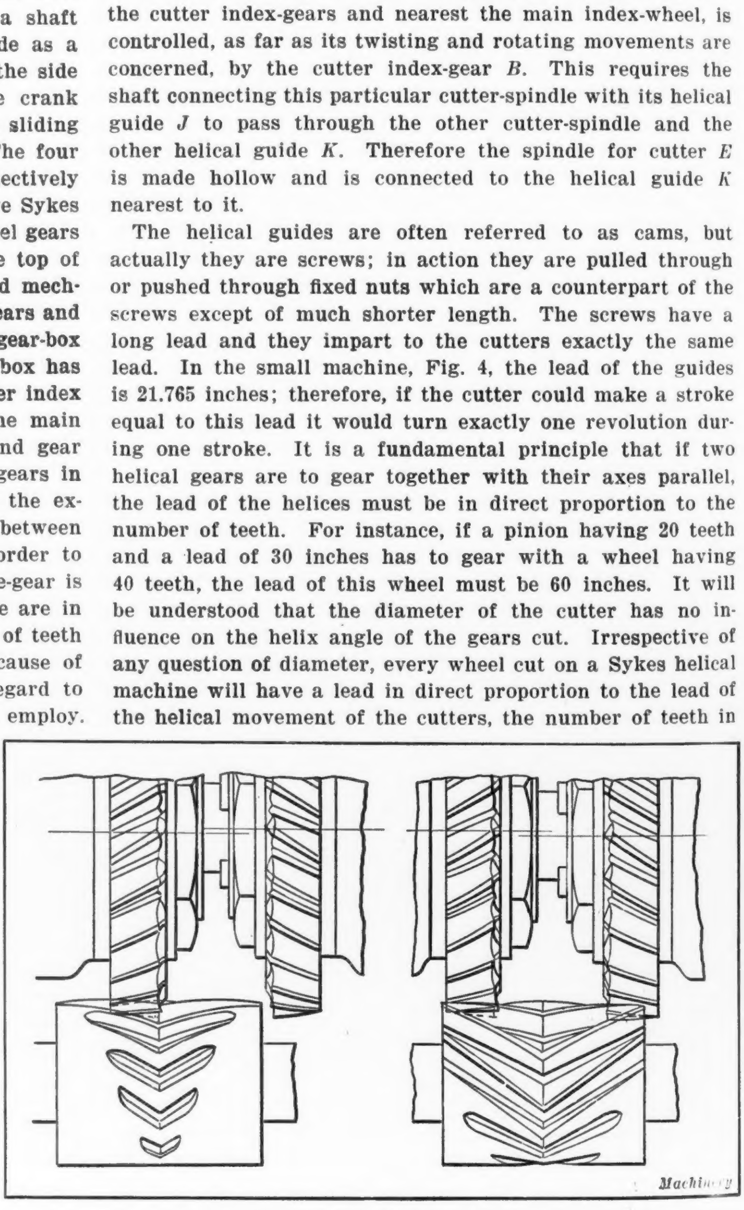


Fig. 3. Diagram illustrating Action of Cutters

the cutters, and the number of teeth cut. The diameter of the cutters does not influence the lead.

The housings containing the cutter index worm-wheels *B* and *C* must move at right angles to the axis of the worm-wheels so as to keep in true alignment with the cutters during the relieving motion. This is only a very slight movement, and it is controlled by the same mechanism that operates the cams on the cutter brackets.

Adjustments of Cutters and Work

The saddles that carry the cutter brackets on the reciprocating carriage are made adjustable in a similar manner to the tool-boxes on the cross-rail of a planer. This construction provides means of adjusting the position of the cutters relative to the wheel blank, and further provides precise adjustment of the position of the cutters at the reversal of their cutting stroke, thus enabling the operator to obtain nicely finished tooth apexes.

There is one other important adjustment necessary. The cutters must be adjusted in a circular direction so as to bring the teeth in each cutter directly opposite the teeth in the other cutter, in order to insure that they will register accurately at the center of the wheel face. This adjustment is obtained by declutching the gears connecting the two cutter index-worms *B* and *C*, Fig. 6, thus permitting either of these worms to be turned by hand independently of the other one.

The connection and disconnection is made by finely serrated clutch teeth which are cut in rings of large diameter. These clutch teeth, being on the worm-shaft, provide very fine adjustment of the cutters, because of the large ratios of the cutter index worm-gear. Each cutter may be adjusted to a limit as fine as 0.0001 inch, and the adjustment may be made while the machine is running; in fact, it is desirable to make it only when the machine is running. The actual gaging of the gears, for tooth thickness, tooth depth, and for position of the apex of the teeth, is all done after the machine is put into operation, by simple means.

The large handwheel seen at the front of the machine (Fig. 4) moves the work-carrying saddle toward or away from the cutters. It also serves to determine the depth the teeth are to be cut. This handwheel will be controlled automatically on the machines now under construction; the illustrations do not show this particular controlling mechanism, which is designed to feed the work toward the cutters and to stop the feeding movement when the right depth is obtained. With this mechanism, the machines are entirely automatic. It is only intended, however, to fit this automatic depth feed mechanism to the smaller sizes of machines, as it is not considered necessary for the larger machines, which are seldom engaged on repetition work.

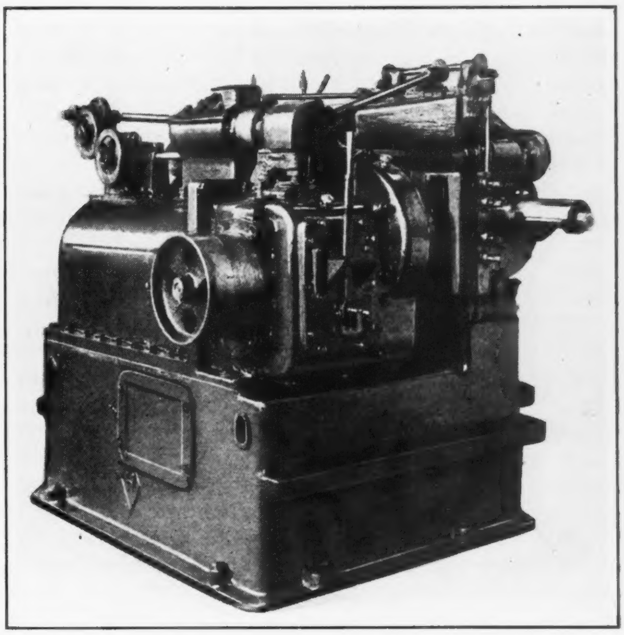


Fig. 5. Rear View of Machine shown in Fig. 4

General Features of the Large Machines

The large size machine (Fig. 1) is the same in principle as the small size just described, although in detail design it is quite different. The reason for this is that the gears cut on the large size machines are much heavier than that part of the machine carrying the cutter-operating mechanism. It has therefore been found advantageous to mount the headstock carrying the wheel blanks rigidly, and to mount the cutter-operating mechanism on a saddle. It has further been found desirable to provide eight speed changes, and in addition a direct motor drive through a magnetic clutch.

Owing to the large size of the machine and the need of the greatest facility in operating and setting up, all control movements are made electrically. The saddle is moved to and fro by an independent electric motor; starting and stopping of the machine is effected through the magnetic clutch already referred to; the feed changes and the disengagement and engagement of the feed mechanism are operated magnetically by means of solenoids. The pump for the coolant is also driven by a separate motor, and there is a fourth motor for turning around the main work-spindle so as to test the accuracy of the arbors and also the wheel blanks after they are mounted. All these electric controls are operated by push-buttons on a switchboard placed in front of the machine. Fig. 1 shows a large (No. 12) machine cutting a large herringbone gear.

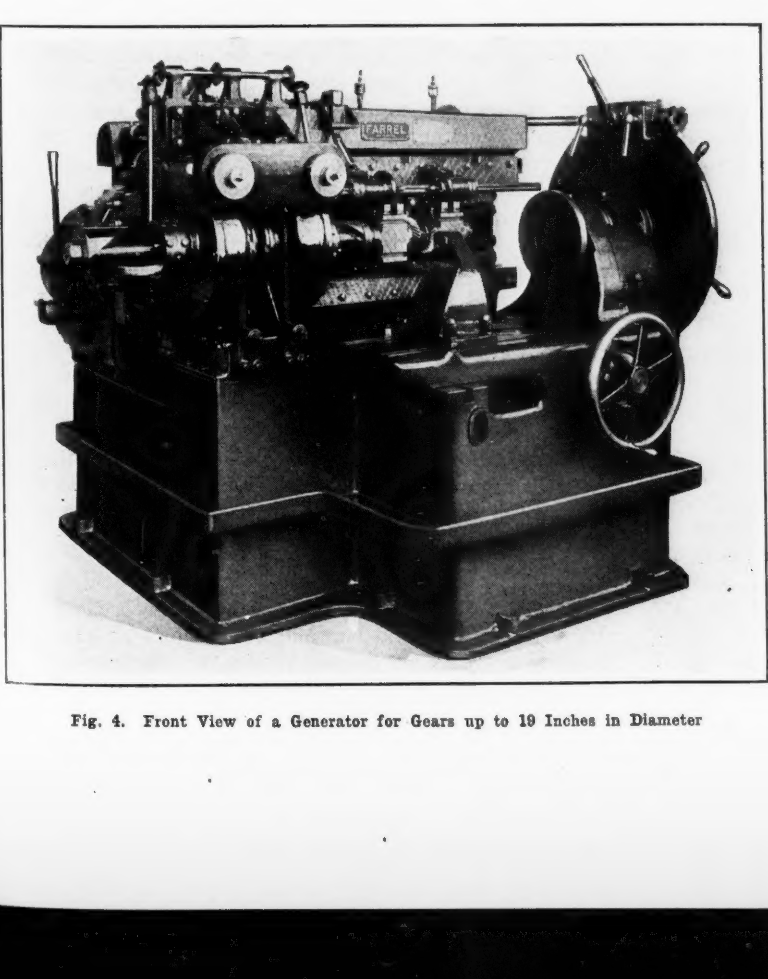


Fig. 4. Front View of a Generator for Gears up to 19 Inches in Diameter

The Cutters

The cutters used in the Sykes generating machines are made with great precision; after they are hardened, they are sharpened on the ends of the teeth only. Irrespective of the outside cutter diameter, which varies slightly, depending on whether a cutter is new or badly worn, the tooth contour is involute to one base circle, and it will therefore always cut the same involute tooth shape whether the cutter is new or almost worn out. All the cutters are made with the base circle near the root of the teeth so that the whole

cutting portion of the tooth contour is involute. The side relief of the teeth of the cutters is made in a definite relation to the top relief, thus insuring that the thickness of the cutter teeth will vary from front to back in correct proportion to the variation in diameter; hence the cutters will always cut exactly the same thickness of tooth in proportion to the depth of tooth. It is claimed that these cutters will consistently generate exactly the same teeth, both as regards thickness and tooth contour, as well as the same helix, whether they are worn or new.

Only one pair of cutters of any particular pitch is necessary to cut all spur gears, as well as helical or herringbone gears, within the capacity of the machine. To change the machine so that it will cut either kind of teeth, the only alteration necessary is the substitution of straight guides for helical guides, and straight-tooth cutters for helical cutters, or vice versa. These changes are easily made and take but a few minutes on the smaller machines. The smaller size cutters are made from solid high-speed steel forgings of the best quality. The larger cutters are made with oil toughened bodies and with high-speed steel teeth which are secured to the bodies and can be changed when worn out or if accidentally broken. From Fig. 2 it will be seen that the sharpening of the faces of the cutting teeth is somewhat special; however, this sharpening is easily done on a standard tool-room universal cutter sharpening machine.

The Sykes machines are made in the following sizes: The No. 1 1/2 machine cuts from 1/4 inch up to 19 inches diameter; 8-inch face, 3 diametral pitch. The No. 2 machine from 1/2 inch diameter up to 30 inches diameter; 12-inch face and 2 diametral pitch. The No. 4 machine from 1 inch up to 53 inches diameter; 18-inch face and 2 diametral pitch. The No. 6 machine from 2 inches diameter up to 72 inches diameter; 20-inch face and 1 1/2 diametral pitch. The No. 12 machine from 3 inches diameter up to 18 feet diameter; 54-inch face, 1 diametral pitch, and 4-inch circular pitch for straight teeth.

* * *

MEETING OF PURCHASING AGENTS

The sixth district conference of the National Association of Purchasing Agents was held October 16 and 17 at the Springfield Chamber of Commerce, Springfield, Ohio. In the iron and steel conference discussion, several Ohio business men took part, including Edward Montanus, Springfield Machine Tool Co.; B. F. Kauffman, James Leffel & Co.; H. O. Miller, American Rolling Mill Co.; A. G. Hopcraft, Ferro Foundry & Machine Co.; and O. A. Ahlers, International Tool Co.

RELATIONS BETWEEN BANKERS AND MANUFACTURERS IN EUROPE

"In considering credit arrangements for the sales of machinery abroad," says W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, "it should be remembered that the business communities in European countries have a very different form of organization from those known in the United States. On account of interlocking directorates, the relationship between banks and manufacturing enterprises in Europe is often very intimate. European banks also are not restricted in the manner common under certain American laws, and consequently are in a position to handle business that here might prove illegal.

"It is not uncommon in Europe for a bank to hold control over an industry through ownership of a majority of its stock, and in some instances these interests are very extensive, with ramifications into many countries.

"If a German salesman in Ceylon accepts an order involving six months' credit, it is possible that the manufacturer will execute the order in the usual way, sending the usual documents forward with the consignment. Upon the arrival of the goods, the salesman secures from his customer an acceptance which, in turn, is discounted at some bank, thus providing funds to meet the draft accompanying the consignment, and the transaction ends with the manufacturer fully paid and the bank extending a credit to the local industry on the security of an acceptance. If this acceptance is discounted without recourse, the manufacturer has no further responsibilities whatever.

"There are countries where customs make it possible to handle business in this manner, but there are other countries where it would be found difficult. Another way has been for the German manufacturer, for example, to discount on his own part in the London market. In pre-war days it was sometimes possible to do this on something like 3 per cent, so that by lending his credit, the German manufacturer was able to make from 3 to 5 per cent interest on the deferred payments during the life of the credit in addition to his usual manufacturing profit. Under such conditions credit transactions were probably attractive, although they involved the manufacturer in serious contingent liabilities."

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The American Management Association held a meeting on "Management Organization and Budgeting" at the Hotel Astor, New York City, October 15 and 16. Papers were read on accounting, office management, production management, budgeting methods, and sales methods.

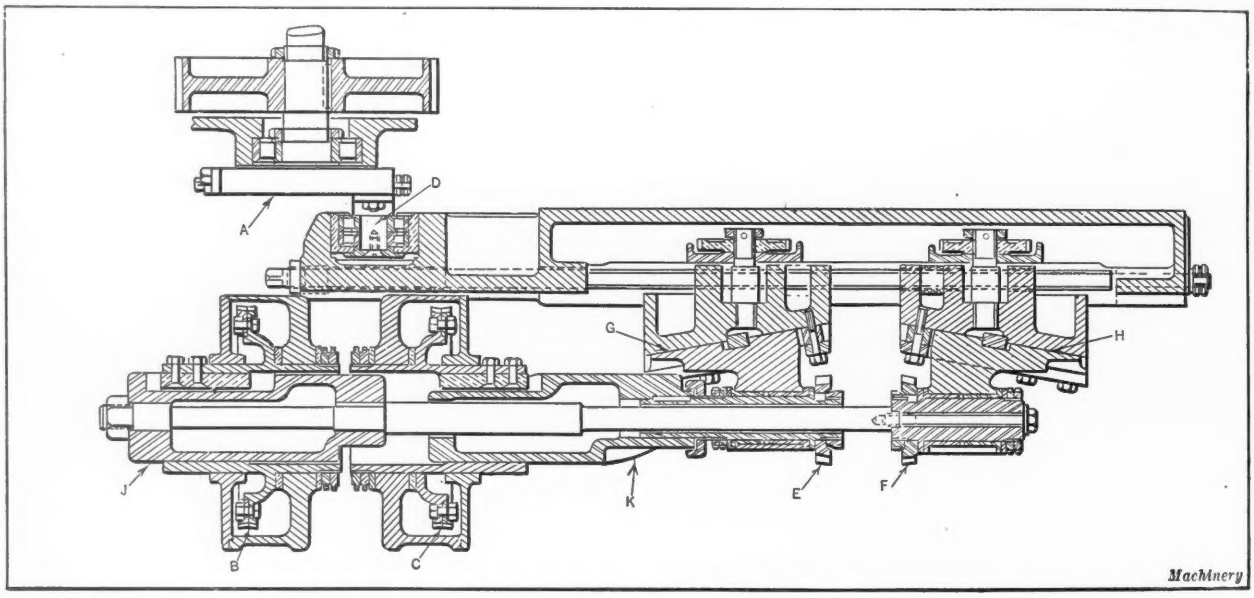


Fig. 6. Plan View of Cutter-operating Mechanisms on Sykes Gear Generators

A BASIC ALLOWANCE AND TOLERANCE SYSTEM

By J. E. CADE

The writer was very much interested in W. L. Hindman's article, "A Basic Allowance and Tolerance System," in August MACHINERY (page 933). In the manufacture of tractors and stationary engines, we have used that system for standard machined holes for the last two years for the very reasons he stated. However, we do not agree with him in dimensioning the shaft the mean size with a plus and minus limit, for the following reasons:

1. The method of showing the maximum and minimum dimension requires less space, both on drawing and gage.

2. The gage-maker is only interested in the two extreme dimensions.

3. The workman is only interested in producing work inside these "Go" and "Not Go" gages.

4. The inspection department is only interested in seeing that the work is held within these two limits. The gage is stored with reference to the part gaged and not according to its size.

A dimension of 1.000 $\begin{smallmatrix} + 0.0005 \\ - 0.0005 \end{smallmatrix}$ would not be so convenient for the toolmaker, machinist, or inspector as only the 1.0005 and 0.9995 dimensions. Mr. Hindman stated as one of his reasons for using the mean dimension on drawings that it shows the machinist the ideal aimed at. However, when a machinist uses a "Go" and "Not Go" gage, the usual practice is to turn or grind the part only enough to allow the "Go" gage to pass over the work, regardless of any mean diameter stamped on the gage. This means the workman will produce the greater part of his work near the maximum diameter, as then there is less danger of scrapping. For that reason, we should aim to have our ideal dimension nearer the higher diameter of the shaft.

* * *

COORDINATION BETWEEN ENGINEERING EDUCATION AND INDUSTRY

In an address made by Samuel P. Bush, president of the Buckeye Steel Castings Co., at the regional meeting of the American Society of Mechanical Engineers at Altoona, Pa., attention was called to the investigation now being made by the National Industrial Conference Board through a committee of industrial leaders and scientific educators, with a view to ascertaining to what extent engineering schools may be better able to train men for industry, and in what way industry may assist engineering schools. Many industrial leaders feel that the graduates from technical schools have not received quite the right training or been given quite the right outlook. It has long been a question as to how this might be done, and it is the purpose of the investigation referred to, to ascertain, if possible, how the problem might best be attacked. It is significant to note that this industrial research is supported liberally and exclusively by industry.

In the same paper it was pointed out that the opportunities for young men with an engineering education to succeed in railroad work are better today than ever before, because a higher class of mental equipment for leadership is required. While the development of railroads might not be so spectacular at present as when new territory was being opened up, the necessity for new and better methods is more urgent than ever. Expenses must be reduced and waste eliminated, and there is no branch of the service that does not face the necessity of invention and progress along those lines.

With the view of indicating the problems still needing attention in the railroad field, the following points are mentioned: Steam railway motive power has not yet reached its final development in regard to economy and performance; the dead weight of railway cars has not yet been reduced to a minimum beyond which further progress is impossible; train resistance can still be cut down by improved designs; the life of rails, ties, wheels, and axles has not yet reached the maximum possible value; the methods for obtaining the most efficient results from labor have not yet been applied, and the best relation between labor and management has not yet been achieved; there are many problems of waste that still must be attacked.

A very important problem is that of avoiding violent fluctuations in the employment of labor in the railway field, as well as in the industries. As a matter of fact, when the industries fluctuate violently in their employment conditions, the railways naturally suffer in the same manner, because they are largely carriers of the materials and products of industry. In an investigation made just before the war, it was found that the steel industry is occupied, on an average, to only 70 per cent of its capacity, and that the bituminous coal mining industry is operated at only 50 per cent of its capacity, while the car and locomotive building industry averages only from 65 to 70 per cent of capacity at all times. In the car-building industry, business frequently fluctuates from an operation of 10 per cent of capacity to full capacity. This represents an enormous waste and seriously affects the welfare and morale of the worker. Here is a waste of energy that presents a problem big enough for the ablest brains.

* * *

WELDING ON BOILERS

By S. W. MILLER, Past President of the American Welding Society

In view of the ever-widening applications of fusion welding throughout industry and the probability that repairs to boilers made in this way will be proposed from time to time, it is well that those responsible for the results should bear several points in mind. For simplicity, these are listed briefly below:

1. Most boilers are insured.

2. Many boiler insurance policies are so worded that if repairs are made without the authority of the company carrying the insurance, the policy becomes void.

3. There are federal, state, and municipal regulations governing this work, as well as those issued by the insurance companies.

4. Only competent welders, used to boiler work, should be allowed to do the welding.

The following precautions should be observed by the owner or his representative:

1. Examine the part of the boiler to be welded in company with the insurance company inspector, and get his approval before doing any welding.

2. Be present at the test after welding with the inspector.

3. If possible, get the inspector to sign a statement that the work has been properly done and that it has passed the test successfully.

4. If the boiler is not insured, and comes under federal, state, or municipal supervision, carry out the foregoing program in company with the proper authority.

If the boiler is neither insured nor under the supervision of some constituted authority, ample precautions should be taken by the welder and the owner to protect themselves against possible future trouble. They should make a sketch of the location and size of the repair, with a clear statement of what was found wrong and how the repair was made. They should always make a hydrostatic hammer test of the finished job, using a pressure of 1 1/2 times the working boiler pressure, in the presence of witnesses, and get their signature to a statement of the facts. These papers should be carefully filed away. In such a case, no welding should be done which is not permitted by law or by good practice. In case of marine work, the welder should pass the regular examination of the Federal Steamboat Inspection Service.

In all cases, the welder should refuse to do work unless authorized by the insurance or other inspectors.

The Machine-building Industries

ALL observers of general business conditions agree that industry continues to operate at a satisfactory rate of activity. The past summer has been characterized by an unusually large volume of business for that season of the year, and most industries report an increase in business activity during the early fall months. The anthracite coal strike has as yet caused no serious difficulties in industrial operations.

The Department of Commerce survey shows increases in business during September in many fields. Pig iron production was 32 per cent greater than a year ago, and 7 per cent in excess of the average production in 1919. Steel ingot production was 23 per cent greater than a year ago, and 24 per cent greater than the average production in 1919. Similar figures could be quoted for many other industries, the only basic fields that are below the general business level being the textile and leather industries.

A continuance of the present building activity for another year, at least, is predicted by the Atlantic States Shippers' Advisory Board. An encouraging factor in this field is that prices of building materials are generally lower than a year ago. The General Electric Co. announces that orders received by the company for the three months ending September 30, amounted to $73,561,000, as compared with $58,390,000 for the same quarter in 1924, representing an increase of 26 per cent. The total increase for the first nine months of the present year over the same period in 1924 amounts to about 10 per cent.

The Machine Tool Industry

Many machine tool builders state that their business has been better during the present year than at any time since 1920. The average of new orders has steadily increased during the past months, and as long as general business conditions continue to be as good as they are, there are prospects for a fair demand for machine tools. Some railroad buying has been reported recently, but on the whole, the railroads have placed but few orders, either for machine tools or for rolling stock. It is stated with a fair degree of certainty, however, that there will be a considerable amount of railroad buying in the equipment field after the first of the year, and this should have some effect upon the machine tool business as well.

The Small Tool Industry

In the small tool industry, business has been quite active for several months. At present, there is a falling off in orders, due mainly to the reduced output of the automobile shops. A feature that characterizes the entire small tool industry is that the number of orders is unusually large, but each order is for a comparatively small volume of goods, so that, while the number of shipments is large, the total volume of sales is not proportionately increased. The policy of hand-to-mouth buying is more accentuated in this field than in any other. The inevitable result of this method of buying will be ultimately to increase prices, because manufacturers cannot carry large stocks on hand, filling rush orders immediately from stock, without being compensated for the cost of carrying such large inventories.

A leading manufacturer in this field states that the present hand-to-mouth buying of tools and supplies will have much the same effect on the manufacturer of tools as the old method of buying five or six months' requirements at once used to have on the user. When a slump came in business, he found himself loaded up with heavy inventories, and for the last three or four years there has been an effort on the part of all concerns to reduce their inventories and to buy tools only as they are needed. In doing this, things have been carried to extremes. As a result, almost every order placed calls for delivery within ten days or two weeks.

The Effect of Hand-to-mouth Buying

In order to meet the demand of the buyer, the manufacturer must have sufficient equipment and a sufficient number of men available at all times to take care of his peak load. This means greatly increased equipment and an over-supply of productive labor, with the result that costs are increased, and ultimately prices will have to be adjusted accordingly. Another difficulty in this field is that the users of tools frequently are not satisfied to use the regular stock product, but nearly 50 per cent of the orders received by one large manufacturer today are for special types or sizes. The orders for special tools come especially from the automobile and allied industries.

Many manufacturers of small tools believe that the time has come when users of their products should reconsider their methods of ordering tools and adopt a procedure that will allow a reasonable length of time for the goods to be produced. The fluctuations in the business of small tool manufacturers from week to week under the present conditions are quite marked, and are bringing about serious problems which can be solved only by cooperation between users and makers of tools. Most manufacturers ought to be able to foresee their requirements in the way of tools sufficiently far ahead so that they can place orders several months in advance setting definite dates of delivery. This would materially help the small tool manufacturer, as he would have a chance to work to given schedules.

Methods of Meeting Increased Costs

Operating costs have had a tendency to increase for some time. A great deal has been done to reduce production costs—in some cases with marked success. To ascertain in a definite way what is being done in this direction, the Federal Reserve Bank of Cleveland recently asked representative manufacturers what specific economies, if any, have been introduced within recent months. The replies received indicate that real progress is being made in this direction. Nearly 50 per cent of the manufacturers stated that they had achieved results by adopting rigid economy.

The two specific methods for reducing costs mentioned most frequently were: (1) The installation of improved machinery and the improvement of present methods; and (2) the reduction of supervision costs through a decrease in the supervising personnel and the employment of a higher grade of personnel. Other improvements mentioned were the reorganization of departments on a more efficient basis, substitution of machinery for hand labor, reduction in the number of types of product made, improvement in the distribution methods and sales organizations, remodelling of plants to promote efficient manufacture and reduction in the haulage of goods.

The Iron and Steel Industry

All indications point to a continued gain in activity in the iron and steel industry. There are signs of increased railroad buying; steel orders, while still small and frequent, show a tendency to increase in size; additional blast furnaces are being blown in; and the pig iron production is close to 75 per cent of capacity. Pig iron prices show a tendency to increase, and large users are said to have placed orders in expectation of a price advance. The United States Steel Corporation is operating at about 80 per cent of capacity, with the independent companies averaging about 75 per cent.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

NILES-BEMENT-POND PLANERS

A new line of planers, built by the Niles-Bement-Pond Co., 111 Broadway, New York City, has been designed to meet all modern requirements as to ease, convenience, rapidity of control, and safe operation, together with ample strength and power, combined with simple and durable construction. The design as developed embodies various new and interesting features, such as complete control of all tool-slides, the cross-rail, the side-heads, and the table movement from a pendent switch, as well as by mechanical means—control of rail-heads from either side of the machine for all directions of feed and traverse, also the clamping, unclamping, raising, or lowering of the cross-rail from either side of the machine. There are automatic safeguards for both operator and machine, and a number of other important features.

Cross-rail Control

A motor *M* mounted at one end of the cross-rail (see Fig. 2) has been utilized to supply power (1) for the rapid traverse of the cross-rail heads and side-heads; (2) for elevating and lowering the cross-rail; and (3) for feeding the cross-rail heads and the side-heads. Assuming that the pendent switch (which hangs in front of the tool-heads, as shown in Fig. 1) is properly set, as described later, the direction of the feeding and traversing movements is controlled by levers *C* and *D*, Fig. 3. Lever *C* controls all the motions of the front cross-rail head. If this four-position lever is thrown to the left, the head moves to the left. If it is thrown to the right, the head moves to the right. Similarly, an upward position of the lever causes the tool-slide to move up, and a downward position reverses this movement. This vertical and horizontal control of the tool-slides applies either for feeding or rapid traversing, and each, in turn, is regulated by the position of the pendent switch. In a similar manner, lever *D* controls all motions of the back cross-rail head.

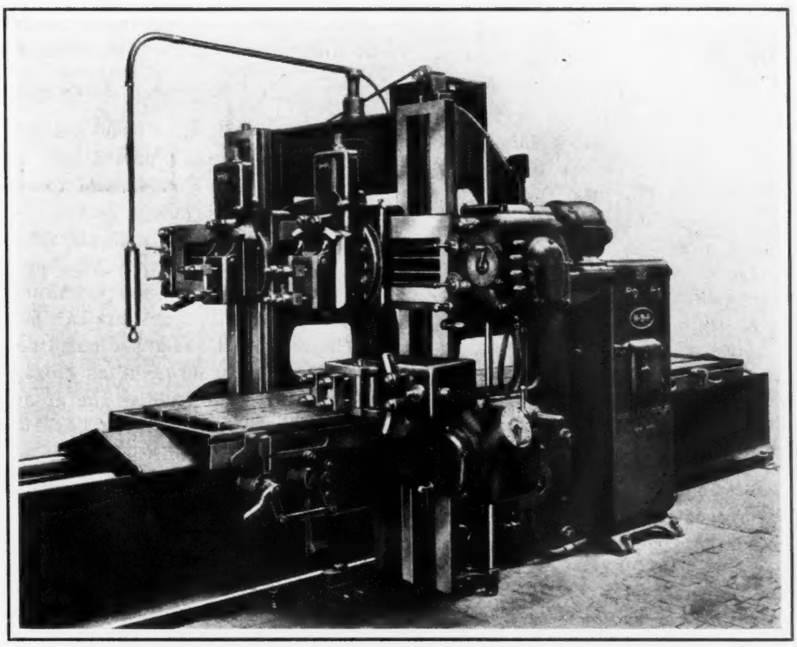


Fig. 1. Niles-Bement-Pond Planer having Duplex Cross-rail Control, Electric Feed, and Other Important Features

The amount of feed for the cross-rail heads is regulated by lever *B*. The amount of feed is indicated by a direct-reading dial. The feed may be varied from a minimum of 1/64 inch by sixty-fourths up to the maximum of 1 inch. An independent feed control lever and dial is provided for the side-head.

Lever *A*, or a similar lever on the opposite side of the machine, is moved up for elevating the cross-rail, and down for lowering it. A duplex control has also been provided for the tool-slides, there being duplicates of levers *C* and *D* at the opposite end of the cross-rail. The levers on the opposite side are directly connected by a rod to the front control levers, no other mechanism being required. This duplex control has a decided advantage, particularly when there are two side-heads, and also for certain classes of work requiring the back cross-rail head. The amount of motion or the distance traversed by the cross-rail heads or the cross-rail itself is controlled by levers *C*, *D*, and *A*, or by twisting the pendent switch knob back and forth, thus starting or stopping the motor at the end of the cross-rail.

Pendent Switch Control

The pendent switch, which may be pulled around to the most convenient position for the operator, is used for the following purposes: (1) For starting or stopping the machine; (2) for "inching" or moving the table intermittently back and forth in setting up work; (3) for controlling the amount of rapid traverse of the heads and tool-slides (when more convenient than using the cross-rail control); and (4) for controlling the elevating and lowering of the cross-rail.

The pendent switch knob has four vertical positions. In the first or safety position all motion is stopped. In the second position down, the pendent switch controls the motion of the main driving motor so that the table can be moved back and forth by twisting the knob in either one direction or the other. In the third position down, the pendent switch controls the feed and traversing motor at the end of the rail; thus as the knob is twisted back and forth, this motor is started or stopped and the distance the heads are traversed is regulated accordingly. In this position, the elevating or lowering of the cross-rail is also controlled.

When the pendent switch knob is pulled down to its lowest position, the main driving motor and the motor at the end of the rail is controlled from the dogs on the table, and the automatic feed is in operation. This is the regular running position. It will be seen that this one pendent switch may be used to control all the operations of elevating and lowering the cross-rail, traversing the heads, moving the table back and forth, and engaging the automatic feed.

The pendent switch is electrically interlocked with the rocker lever at the side of the bed, so that when the switch is pushed to the upper position, the rocker at the side of the bed is made inoperative. This pendent switch control also makes it possible to interlock the driving motor and the cross-rail motor so that it is impossible to start up the table while traversing, and also impossible to traverse while the table is moving back and forth.

In setting up a job, the operator would first push the knob to the highest position, so that if any one came along, the

table could not be started by knocking against the rockers at the side of the bed. For setting the tools relative to the work, the table with the work would first be "inched" up to the tools by pulling the pendant switch to the second position and twisting the knob back and forth. In setting the tool, the four-position lever which controls the direction of motion of the head, whether to the right, left, up, or down, is thrown in the direction desired and the tool traversed quickly to the desired point by a twist of the knob when in the third position down. As the tool nears the work, the knob would be twisted back and forth so that the tool would be "inched" to exactly the required position. In doing this, the operator can lean over the table and observe the exact setting of the tool, at the same time holding the pendent switch control in his hand.

Electric Feed

Ordinarily, on planers of this size the common practice has been to obtain the power for feeding the heads from the driving gears in the bed. This has made it necessary to connect the driving gears in the bed with the feed mechanism at the end of the rail and in the side-heads, through various gears, shafts and brackets with their bearings. In the case of the electric feed, the placing of the feed motor directly on the end of the rail has eliminated this mechanism.

If the feed is taken from the driving gears in the bed, the amount of feed possible with a short stroke is proportional to the length of stroke. With the electric feed, as the rocker mechanism on the side of the bed is thrown over to reverse the driving motor on the table, the feed motor is simultaneously energized and the feed takes place immediately. In this way, the time taken for the planer to reverse is utilized in feeding the heads. Due to this, the maximum feed may be secured even with the shortest stroke.

In this machine, the change in direction of feed is secured by single four-position levers *C* and *D*, Fig. 3. Sometimes the operator wishes to feed at the end of the cutting stroke, and at other times at the beginning of the stroke. On this machine, the rocker on the side of the bed has been arranged to energize the feed motor at either end of the stroke, merely by throwing the switch *S*, Fig. 2. The feed is positive, there being no frictions or springs to get out of adjustment.

A safety coupling *V* has been provided between the motor on the rail and the transmission. This coupling will slip when the load has reached a predetermined amount; hence, the machine will be protected against damage if the operator traverses or feeds the cross-rail heads together, if he traverses or feeds the side-heads up against the cross-rail, or if he lowers or elevates the cross-rail against any obstruction.

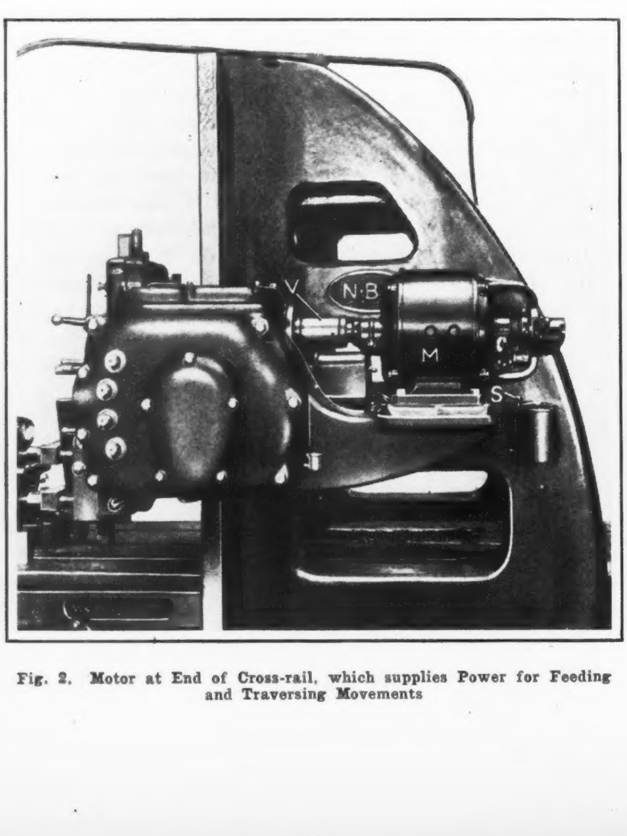


Fig. 2. Motor at End of Cross-rail, which supplies Power for Feeding and Traversing Movements

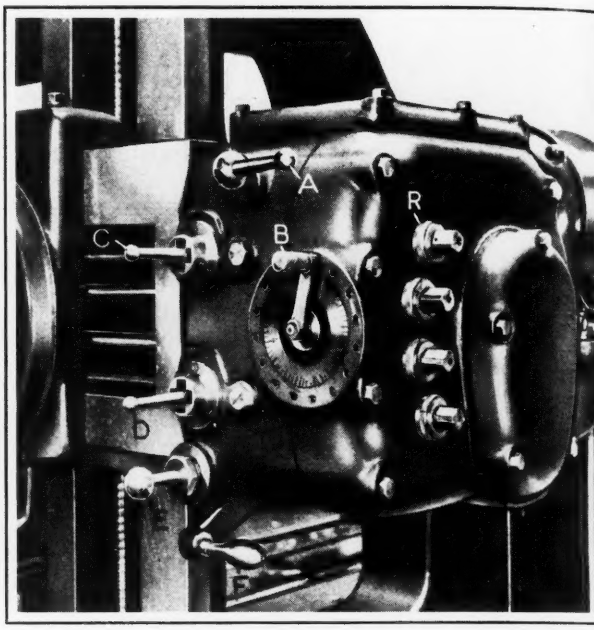


Fig. 3. Levers at End of Cross-rail for controlling Feeding and Traversing Movements

Cross-rail Heads and Tool-slides

The cross-rail has been designed to resist the upward bending moment by providing a stiffening web on the top of the rail (see Fig. 4) and to resist the torsional strains and backward bending moment by making the cross-rail deep. This, together with the cross-rail gibs on the outside of the housings and the clamping gibs on the inside, gives the cross-rail the necessary stiffness. Thus heavy roughing and accurate finishing cuts can be taken.

The cross-rail heads are offset so as to permit the tools in the heads to be brought as close together as possible. In order to give the saddles the greatest strength to resist the cutting tool pressure, they have been made solid to extend around the back of the upper rail, as shown in Fig. 3. Micrometer collars *R*, Fig. 3, have been provided for each head so that the vertical distance traversed by the tool-slides may be accurately gaged, as well as the horizontal distance moved by the head along the cross-rail. A clamp lever has been provided to clamp each tool-slide to the swiveling member. Clamps have also been provided for clamping the saddles to the cross-rail and the side-heads to the housings.

The side-head has been designed so that the side-head tool can be brought up close to the cross-rail tool without any overhang on the cross-rail tool-slide. In order to make this possible, the side-head has been offset, the feeding and traversing mechanism being below the head. The side-head tool is also in the same vertical plane as the cross-rail tool. If these tools are not in the same vertical plane, the table stroke for any job requiring the side-head will ordinarily have to be increased a distance equal to the horizontal distance between the tools.

Single-lever Cross-rail Clamp

In this machine, the cross-rail is clamped by movements of the clamping lever *F*, Fig 3. A similar lever is located on the other side of the machine. At the center of the horizontal shaft to which these levers are attached is keyed a cam, so that as the clamping levers are moved back and forth, the steel plate *G*, Fig. 4, moves in and out, due to the action of this cam. This steel plate transfers the clamping force to the ends of the clamping levers *H* and *K*, which have fulcrums near the housings. The purpose of the steel plate *G* is to equalize the clamping force on each housing.

The hand clamping levers are interlocked with the cross rail elevating levers, so that it is impossible to engage the

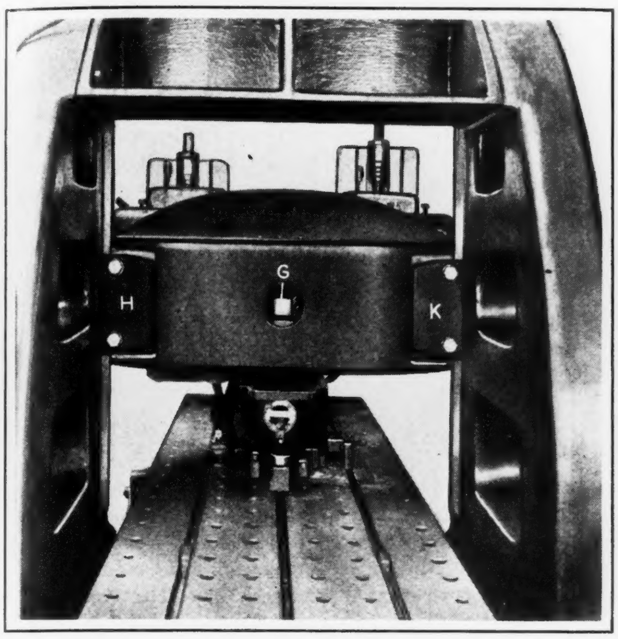


Fig. 4. Rear View of Cross-rail, showing Clamps and Extra Stiffening Web

latter for elevating or lowering the cross-rail while it is clamped. It is also impossible to clamp the cross-rail while the elevating lever is in the raising or lowering position. The elevating levers have been duplicated on each side of the machine. The elevating screws are stationary, and on these screws are bronze rotating nuts. The cross-rail may be squared at any time merely by adjusting the nuts at the top of the housings. The elevating nuts operate on ball bearings to reduce the friction to a minimum.

Materials and Lubrication

The same gears are used for traversing, feeding, and elevating the cross-rail, and are all contained in the gear-box at the end of the cross-rail. These gears are made of heat-treated steel and hardened. The gear-box is totally enclosed, is dust-tight, and has flood lubrication. As an additional precaution, a single shot lubricator *E*, Fig. 3, has been provided to force oil up to a reservoir in the top of the box, from which it is led by tubing to the various bearings. All screws and rods have a double bearing in the gear-box, so that there are no overhung gears.

The driving gears in the bed and the table rack are all made of steel and generated according to the Maag system. These gears run in oil, and in addition have oil pumped through to them directly. The driving gears are bronze-bushed and rotate on fixed shafts. Holes have been drilled down the center of these shafts with connecting holes to the bushings so that oil is pumped directly to the gear bearings. An oil-pump is driven from the driving gears in the bed for furnishing forced lubrication to the table ways, the oil being distributed evenly over the entire bearing surfaces through oil-grooves. These planers are built in 36-inch, 42-inch, and 48-inch sizes.

DAVENPORT AUTOMATIC SCREW MACHINE

One of the principal features of an improved automatic screw machine recently brought out by the Davenport Machine Tool Co., Inc., Rochester, N. Y., is speed of operation. Certain brass pieces can be produced at the rate of one per second, using a tool in each of the five tool-head spindles, on the two tool-arms, and on the three tool-slides. A typical example, which is about 1/4 inch long and made from 7/16-inch brass stock, is rough-turned, finish-turned, knurled, centered, drilled, tapped, recessed, and cut off. In such high-speed operations, the work-spindle turret is indexed once every second, and the tools are moved to and from the work as often, but with more complicated brass and steel pieces, less frequent indexings and tool movements are readily obtained by the use of change-gears.

Important changes in design have been made in the drive to the threading spindle, the starting clutch, the mechanism for indexing the work-head, the mechanism for locking the work-head, the means employed for opening and closing the work-spindle chucks, and the arrangement used for feeding the stock. Another improvement is that all gears, with the exception of several worm-gears, are now made of steel. As in previous Davenport automatic screw machines, there are five work-spindles contained in an indexing head, and the work is fed forward while being indexed from the cutting-off station to the first working station. The general details of operation follow closely those of the previous machines.

Either a motor or belt drive can be supplied. In the case of a motor drive, the motor is mounted beneath the bed, as illustrated, and drives through a silent chain to a shaft at the back of the machine. From this shaft power is taken direct for driving the work-spindles and the work-spindle head, and is also conveyed to a lower shaft on which the driving clutch is mounted within housing *A*, Fig. 2. The clutch is of the well-known automobile design, and is operated from the front of the machine through the vertical lever *B* seen at the left-hand end in Fig. 1. The drive to the work-spindles is continuous unless a stop mechanism is provided, in which case a spindle can be made stationary when the work-head is locked. The drive to the spindles is accomplished through a large ring gear having teeth cut on both the outside and inside. A spur pinion on each work-spindle meshes with the internal teeth of this ring gear.

At the right-hand end of the machine there is a shaft *C*, Fig. 1, on which cams are mounted for controlling the feeding movements of the tool-spindles through a series of levers *D*. On each of these levers there is a finished circular surface on which a block is adjustable to regulate closely the amount of movement given to the tool-spindle. This block is connected to the spindle through a turnbuckle, for easy adjustment of the tool position. The amount and rate of feed, of course, is controlled by an individual cam on shaft *C*.

When a threading spindle is mounted on the tool-head, this spindle is fed forward at the proper rate by gears driven from a shaft running along the back of the bed, as shown in Fig. 2, and the spindle is returned by a second set of gears which change the speed of rotation and increase the rate of the horizontal movement. The tool-slides and arms pre-

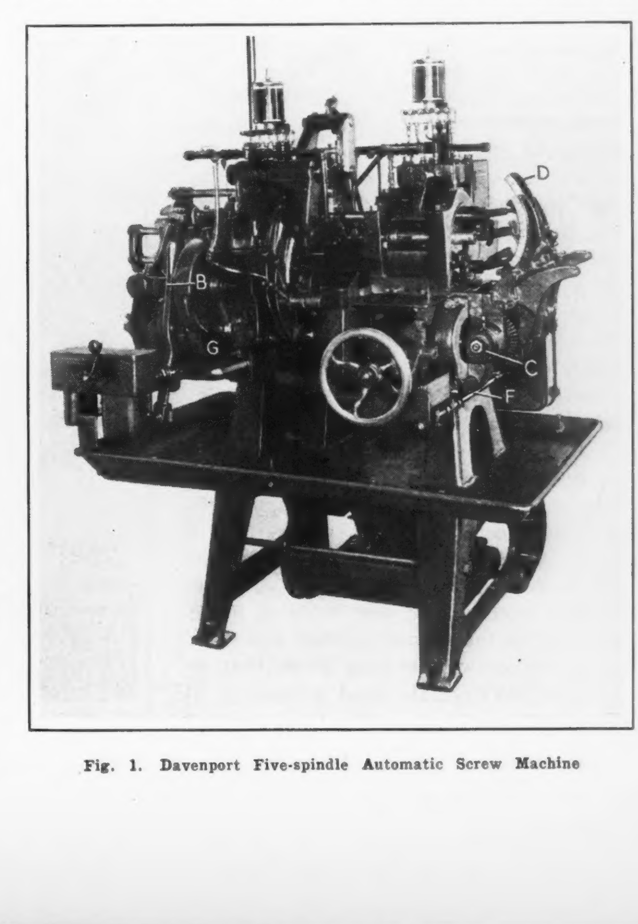


Fig. 1. Davenport Five-spindle Automatic Screw Machine

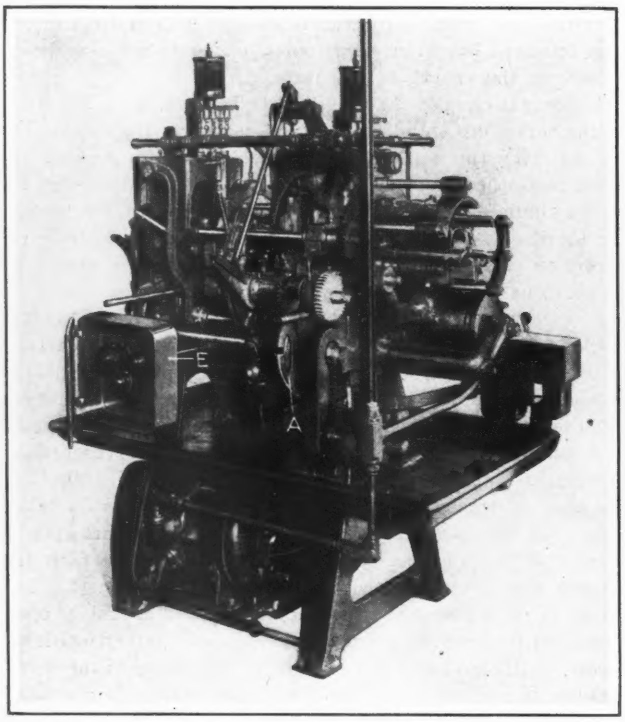


Fig. 2. Rear View of the Automatic Screw Machine illustrated in Fig. 1

viously referred to, which are used in taking turning, forming, and facing cuts on the work, are also moved to and from the work by cams. An overhead tool can be mounted in the fourth position of the tool-spindles for finish-sizing, thread-rolling, or similar operations.

At the forward end of shaft *C*, there is a miter gear which delivers power to a shaft running along the front of the machine, from which power is obtained for indexing the work-head, locking and unlocking the work-head, opening and closing the spindle chucks as they reach the stock-feeding position, and feeding the stock. It is usually desirable that certain mechanisms move at a faster rate during the indexing period than during the cutting period, so that unlocking, indexing, and locking of the head, opening and closing of the chucks, feeding of the stock, and the return of the tool-spindles can be quickly accomplished. Hence, provision is made for running shaft *C* at two different speeds.

The slower of these speeds is obtained through the change-gears in box *E*, Fig. 2, while the faster speed is obtained direct from the main drive. The two different speeds of shaft *C* are obtained at the proper time through the operation of two clutches by rod *F*, Fig. 1, which is moved back and forth by a lever actuated by a cam at the right-hand end of the shaft running along the front of the bed. When work is to be produced at the rate of one per second, shaft *C* and the shaft on the front of the bed are operated continuously at the high speed, the clutch furnishing the high-speed drive to shaft *C* being then locked in mesh.

Indexing of the work-head on this improved machine is accomplished by means of a Geneva movement, which is actuated by a roller on cam *G* near the left-hand end of the shaft running along the front of the bed. The indexing time is only 2/5 of a second. A plate cam on the same shaft functions to release a large cap, which binds the work-spindle head and holds it firmly during an operation, and another cam operates to withdraw a locking block that locates the work-spindle head accurately at each indexing. At the same time, another cam on drum *G* opens the chuck of the spindle that happens to be in the cutting-off position, and during the indexing still another cam on drum *G* causes the stock to be fed forward in the spindle that is approaching the first station. When this station is reached, the spindle chuck is automatically closed, the locking block locates the work-spindle head, and the binding cap is retightened on this head. The amount of stock fed can be varied by simply turning a small handle on the feeding mechanism.

Lubricant is furnished to all important points from overhead sight-feed oil-cups, while coolant is delivered to each work-spindle by a pump. This machine receives bar stock up to 1/2 inch in diameter, and has a standard stock feed of 3 inches, and a tool feed of 2 1/2 inches, although a double arrangement can be provided to feed a bar 3 3/4 inches in diameter.

CINCINNATI "HYPRO" OPEN-SIDE PLANER

A "Hypro" open-side planer has just been brought out by the Cincinnati Planer Co., Cincinnati, Ohio, which embodies all the features incorporated in the double-housing planers described in the April and October numbers of MACHINERY, in addition to several other features. The selective dial feed is furnished for all heads, as may be seen in Fig. 1, a single turn of the knob on the dial giving a range of feeds of from zero to one inch. All feeds operate independently of each other and are fool-proof.

Turning the crank-handle at the end of the rail automatically locks the rail and knee to the column at four places, in a manner that gives the same rigidity as when bolts are tightened separately. To eliminate accidents, the elevating mechanism is automatically disengaged when the rail is clamped. The handle for lowering and raising the rail is placed on the front, in a convenient position for the operator. When the rail is in its extreme high position, a similar handle on the side-head can be used to lower it. An automatic trip disengages this mechanism when the rail has been raised to the extreme position.

A safety trigger gear has been placed on the rail and side-heads. A knurled knob which eliminates all danger of the operator catching his fingers is used to change the direction of the feed. A rapid power traverse is furnished to every head, and controlled from a handle placed on the end of the rail or on each side-head. All heads are independent of each other, so that it is possible to feed one head and use the rapid power traverse with any of the others. An automatic clutch disengages when the heads run together or against the work, or when the side-head runs against the rail.

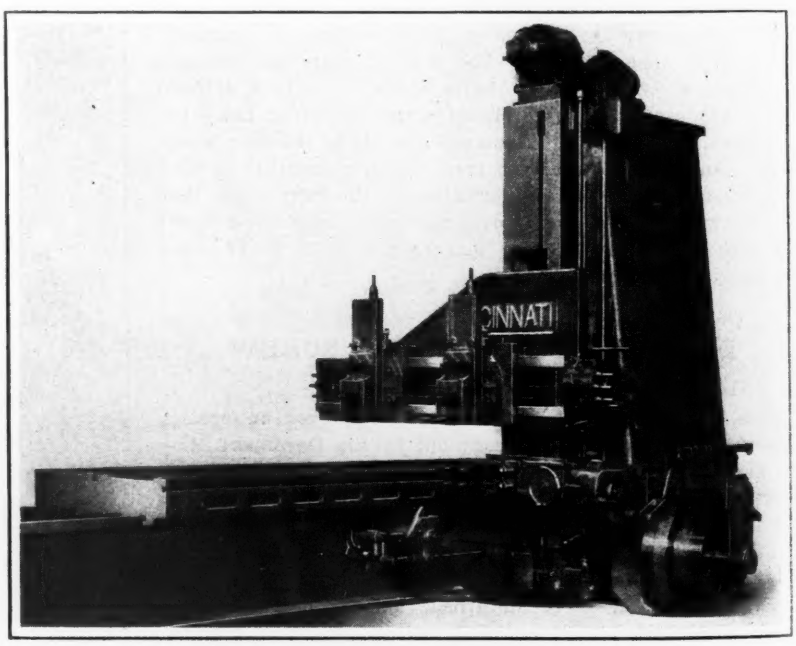


Fig. 1. Cincinnati "Hypro" Open-side Planer

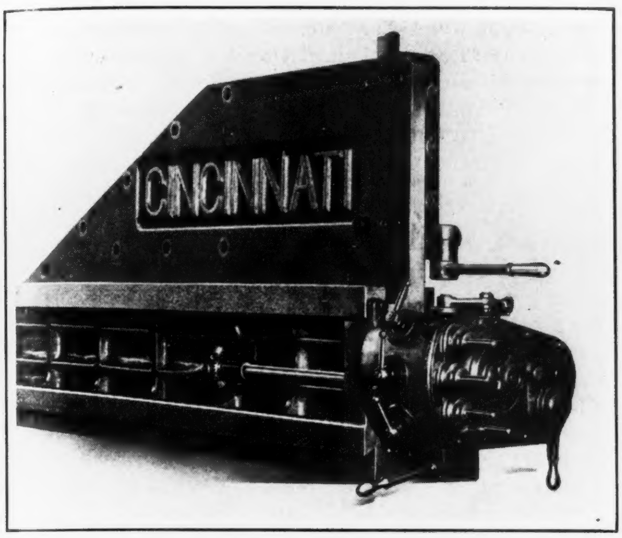


Fig. 2. Illustration which shows that the High Wall of the Rail is Integral with the Rail Casting

On all heads the slides are made with the inverted dovetail shown at *A* in Fig. 3. This design is said to increase the strength of the slides without increasing the distance from the face of the housing to the tool, and to cause the dovetail to become tighter under pressure. Taper gibs are used throughout the machine. The control of the entire machine is accomplished from the normal working position of the operator.

Lubricant for the vees, main bearings, and gears is supplied by a reversible pump placed inside the bed under the tank that contains the oil. It is forced through a filter before being distributed to the vees and bearings. The oil is forced into a chamber around the main bearing, and before reaching the shafts it must again pass through felt wicks to give it a second filtering. For oiling the vees, the lubricant is forced through channels which run the full length of the table to insure oil being on the vees at any point under all conditions. Oil taken from the same source is sprayed on the gears. There are a few additional oil distributors which require filling once every two weeks to lubricate all revolving parts and sliding surfaces of the saddles and slides. The saddles ride on a film of oil when moving along the rail.

The bed is double the length of the table so that overhang is eliminated when using the table on the extreme ends. Both the bed and table are of box type construction. The table is furnished with inner guides which fit between the vees and tend to absorb all side thrust. A clamp on the outside of the bed eliminates any possible chance of tilting the table when machining overhanging work.

The rail and knee construction are such that spring has been practically eliminated. Fig. 2 shows the rail casting, from which it will be noted that the high wall of the rail is integral with it. The outline of the knee is exactly like that of the rail. The bearing of the knee and rail on the column and of the column on the bed is large. In designing the column, the barrel type of construction was followed, as may be seen from the cross-sectional view shown at *B*, Fig. 3. The barrel has been placed inside the column and provides space for the side-head counterweight.

"HERCULES" DRILLS

The original "Hercules" No. 550 high-speed drills manufactured by the Whitman & Barnes Mfg. Co., Akron, Ohio, were made with a hub at the large end of the shank. This was done to give additional strength to the already oversized shank to permit driving the tool better. For certain jig work and in multiple-spindle presses, this hub was sometimes objectionable, and so a new process of making shanks has been developed which does away with the hub and permits the use of these drills wherever a standard sized drill may be employed. This new drill is known as the "Hercules No. 555." A straight-shank "Hercules" No. 444 drill has also been brought out, which differs from the No. 555 only in the shank. This drill is believed by the manufacturer to be the only straight-shank drill of this type ever placed on the market. The two new drills replace five former ones.

Other new developments are the "Hercules" No. 555-H taper-shank oil-hole drill and the No. 444-H straight-shank drill. All "Hercules" drills are processed and twisted hot, and the flutes accurately milled. Over-all and flute dimensions correspond throughout the line, and in the carbon taper- and straight-shank tools, these dimensions are made to correspond with their counterparts in the high-speed drills.

DAVENPORT "NON-STOP" SEMI-AUTOMATIC MACHINE

A single-purpose two-way rotary type of machine has recently been placed on the market by the Davenport Machine Tool Co., Inc., Rochester, N. Y., for drilling, turning, threading, or tapping parts on a high-production basis. It is especially adapted to drilling such parts as automobile door hinges, shackle bolts, and turnbuckles. The speed of operation depends upon the abilty of the operator to reload the work, and in the case of automobile door hinges, a production of 1600 pieces per hour is averaged. These hinges are made from cold-drawn steel stock, and in one piece a 1/4-inch hole is drilled completely through a boss 15/16 inch long, while on the other, 1/4-inch holes are drilled through two bosses 3/8 inch long.

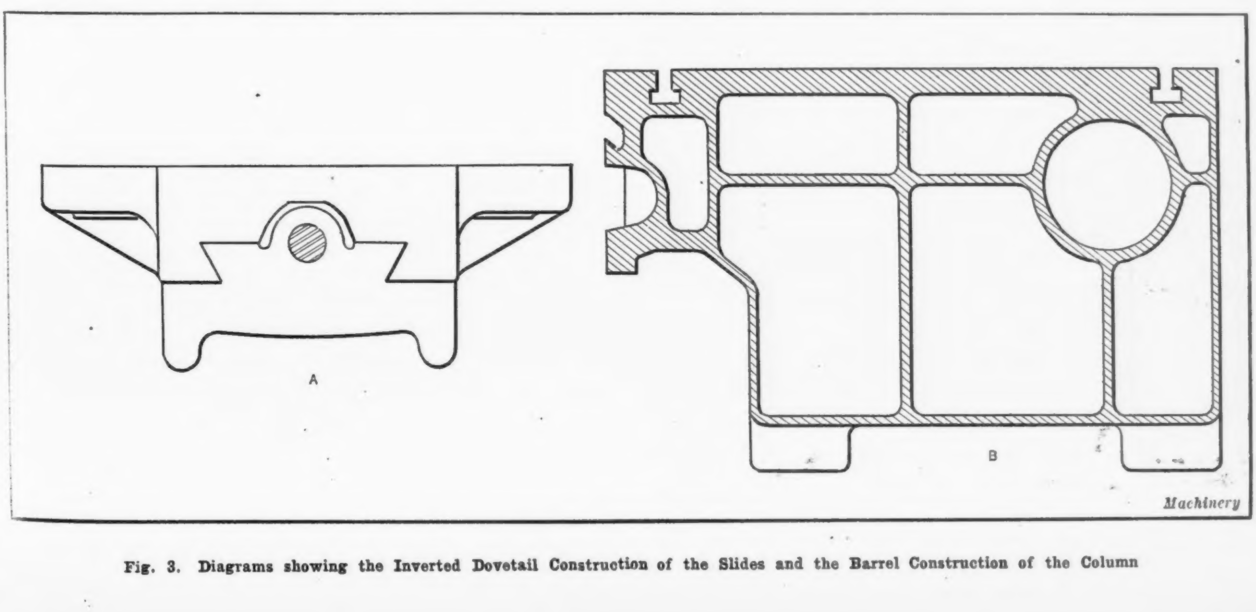


Fig. 3. Diagrams showing the Inverted Dovetail Construction of the Slides and the Barrel Construction of the Column

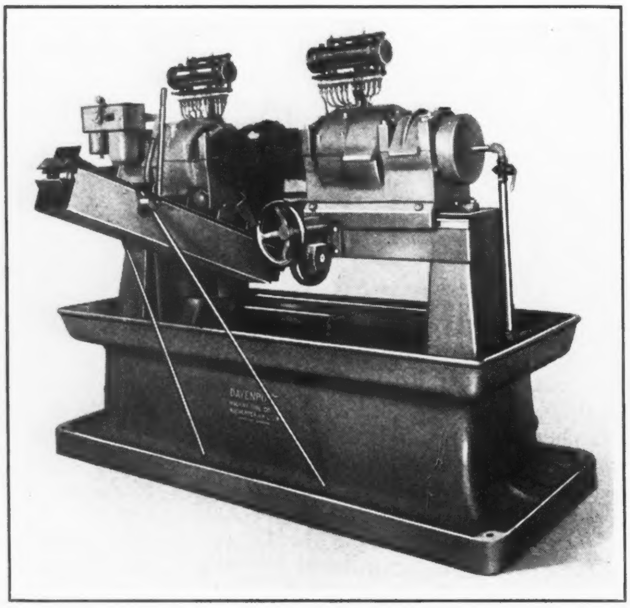


Fig. 1. Davenport "Non-Stop" Semi-automatic Single-purpose Machine

As may be readily seen in Fig. 2, the machine is equipped with two heads, in each of which there are five tool-spindles. Between the tool-heads there is a holder containing jigs on which five pieces of work can be mounted at one time. The tool-spindles revolve continuously on their own axes, and the tool-heads also revolve, carrying the work jigs with them. With this arrangement, a piece of work is loaded as each jig successively reaches the loading station, and then the part is drilled or tapped, etc., as it is revolved about the axis of the jig-holder. As the tool-spindles revolve about the tool-head axis, they are fed toward the work at the same time, and then returned as the operation is completed. The speed and feed of the tools may be proportioned to suit the cycle of the machine. As each piece of work reaches the loading position, the jig is automatically unclamped and the work slides out. After the operator has reloaded, the new piece of work is automatically clamped. The construction of the jigs naturally depends upon the shape of the work.

In drilling one long hole with two opposing spindles, as in the case of the door hinge, one drill is advanced somewhat less than half the distance through the piece and then rapidly withdrawn, while the second drill is fed more than half way so as to break through the remaining stock. The machine is driven by a motor contained in the base, which drives through a silent chain and change-gears to a shaft running along the back of the machine. On this shaft there are two gears, each of which delivers power to a large gear on each head which has external and internal gear teeth. The outer teeth are used in driving the large gear, and the internal teeth each drive the tool-spindles on their own axis as the head revolves. The spindles in the two heads revolve in opposite directions.

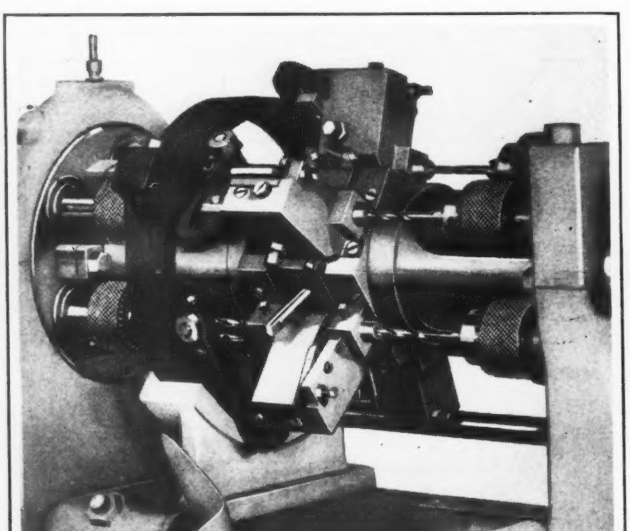


Fig. 2. Close-up View, showing the Construction of the Jigs and Jig-holder provided for drilling Door Hinges

Rotation of the work-holder with the two spindle-heads is accomplished by mounting the holder on a large sleeve which is connected at the ends to the two heads. With this arrangement, it is only necessary to drive one of the heads, as the work-holder causes the rotation of the other. The feed and withdrawing movements of the tool-spindles are accomplished by equipping each spindle with a roller which engages a cam located near the end of the machine and which extends around a complete circle. The handwheel on the front of the machine provides a means of "turning over" the machine by hand when setting up. Coolant is delivered by a pump to the rear of each tool-head arbor and then to the individual tool-spindles. Sight-feed oilers are furnished for delivering lubricant to all important bearings. The particular machine here illustrated is equipped with a conveyor for quickly carrying away parts as they are finished.

HALLOWELL WORK-BENCH

A work-bench of the design shown in the accompanying illustration has recently been placed on the market by the Standard Pressed Steel Co., Jenkintown, Pa., for use primarily in garages or in homes. It is made up of "Hallowell" pressed-steel bench legs and four pieces of planking. The boards and legs are furnished with bolt-holes and bolts, ready for assembling. A drawer with a tray can be furnished and a machinist's or cabinet-maker's vise can be applied. The bench is 48 inches long, 15 inches wide, and 32 1/2 inches high.

Hallowell Work-bench with Pressed-steel Legs

ELECTRIC COMPENSATOR FOR PYROMETERS

Temperature fluctuations of thermo-couple cold junctions of pyrometers are compensated for electrically by an improved automatic compensator placed on the market by the Wilson-Maeulen Co., 383 Concord Ave., New York City. The new compensator is provided with practically all pyrometer equipment now being installed by this company. It is claimed that the compensator eliminates an important source of error in pyrometer installations and that thermostats, water-cooled cold junctions, or buried cold-junction wells are unnecessary. The compensator employs a wheatstone bridge connected in the thermo-couple circuit. Three sections of this bridge are resistances composed of materials

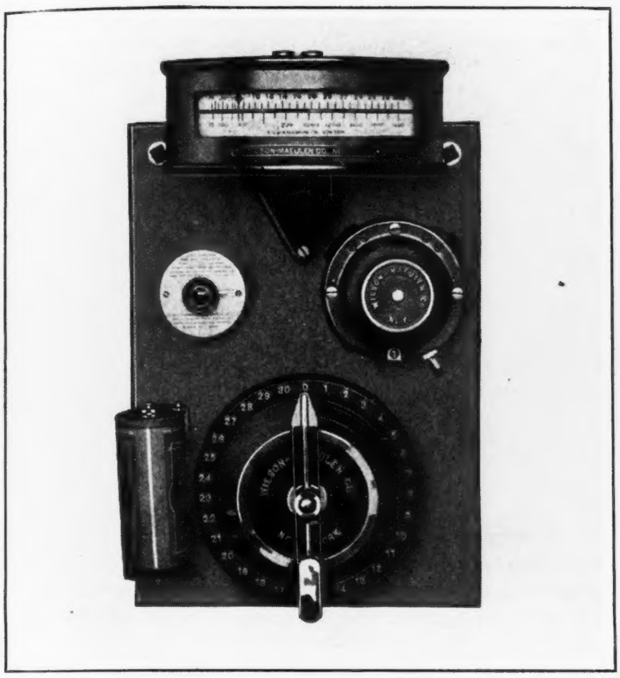


Fig. 1. Wilson-Maeulen Indicator Pyrometer with Automatic Electric Compensator

of constant resistance, and the fourth section is made of a material that alters in resistance in response to temperature changes, and thus alters the current from a dry cell connected to the wheatstone bridge. This temperature responsive coil and the thermo-couple cold junction are both located at the instrument panel where they are subject to the same temperature changes.

The method corrects the thermo-couple current entirely independent of the instrument, and does not involve any mechanical or electrical movement or correction inside the instrument. For this reason it permits convenient checking of instruments. The same compensator can be interchanged on instruments of various ranges having the same type of thermo-couple, and it can be applied to double-range instruments by using two compensators, one for each range.

When indicating and recording pyrometers are used in combination, one compensator is sufficient for both the indicator and the recorder, since the correction is made in the thermo-couple current. Installation of pyrometer equipment is simple, because the wiring and connection of the compensator is done on the instrument panel at the factory, and the user only has to run a pair of extension leads from each thermo-couple to the instrument panel and make connections there.

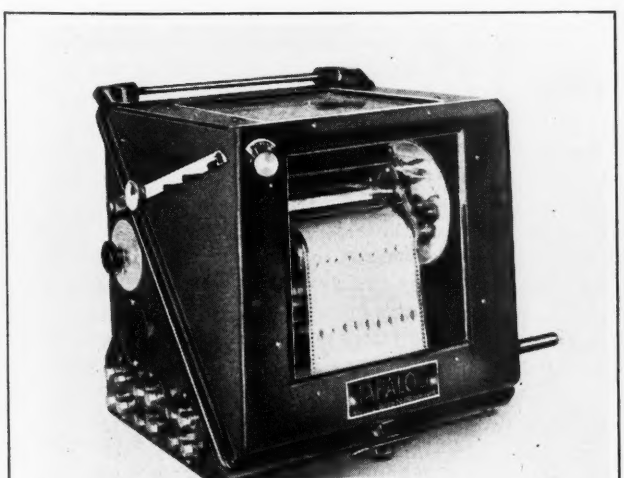


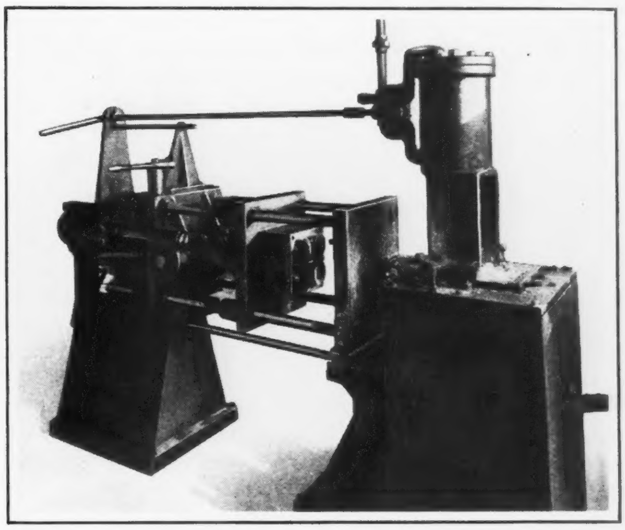
Fig. 2. "Tapalog" Multiple Pyrometer Recorder equipped with Automatic Compensator

SIMPLEX DIE-CASTING MACHINE

A machine for die-casting a variety of parts from zinc-base metals, white brass, etc., is being introduced to the trade by the Simplex Casting Machine Co., Inc., 12th and Pelham Sts., Brightmoor, Mich. This machine is semi-automatic, air-driven, and uses oil, gas, or electricity for keeping the melting pot at the desired temperature. Operation of the machine is controlled by means of two levers, one of which governs the carriage mechanism, and the other the flow of molten metal into the die.

Dies with a multiple number of impressions can be used to advantage. The dies are water-cooled to allow maximum production and long life, and they are lubricated by the Alemite system. Power for moving the die carriage is derived from two air cylinders, one on each side of the machine. These cylinders operate racks which revolve pinions on the two ends of a crankshaft. The crankshaft is direct-connected to the die carriage for sliding it back and forth relative to the stationary die. A patented locking mechanism is provided for the crankshaft.

The nozzle is of a patented design which is said to insure a clean flow of metal into the die. Interchangeable cylinder sleeves are furnished, so as to reduce to a minimum the cost of replacing these parts. The machine operates on on air pressure of about 2000 pounds per square inch, using a line pressure of 100 pounds per square inch. In the illustration, the machine is shown set up for casting drain plugs for

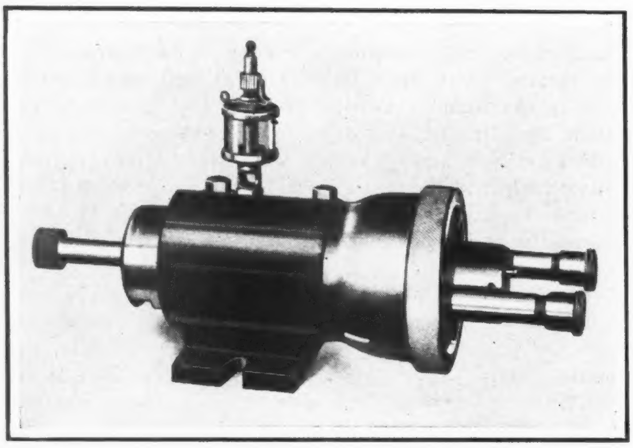


Simplex Die-casting Machine for producing Parts from Zinc-base Metals, White Brass, etc.

wash basins or bath tubs, four at a time. Production on this operation averages 800 pieces per hour, with a four-impression die.

EX-CELL-O AIR-DRIVEN GRINDING SPINDLE

An air-turbine-driven grinding spindle intended for grinding holes from 1/4 to 1 inch in diameter constitutes the latest development of the Ex-Cell-O Tool & Mfg. Co., 1469 E. Grand Blvd., Detroit, Mich. This spindle is equipped with a governor control to maintain the speed at a predetermined value regardless of whether the grinding wheel is cutting or the spindle is running idle. The governor operates through the medium of an electrically controlled relay and a solenoid-operated valve, which are so designed that wear is negligible. It is claimed that these parts will remain in an operative condition over an indefinite period of time and that because no delicate adjustments are required, the device is practically fool-proof. Electrical energy is required only while the wheel is actually cutting, and it is stated that this cost is not more than one or two cents per eight hours of operation.



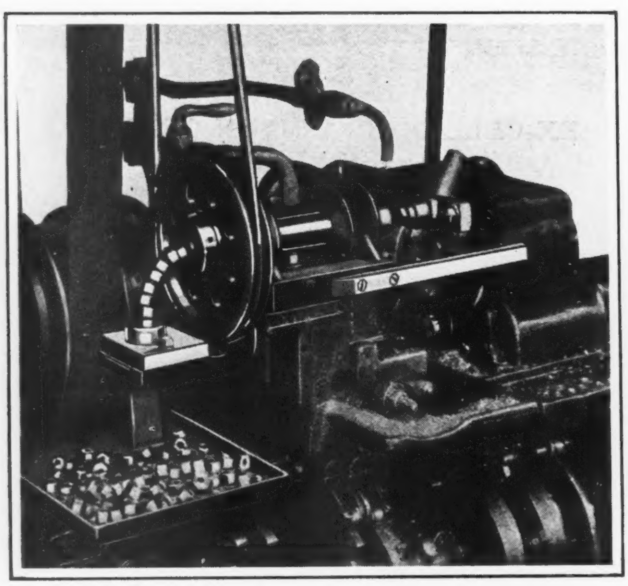
Ex-Cell-O Air-turbine Driven Grinding Spindle with Governor Control

This spindle is designed for continuous operation at speeds up to 30,000 revolutions per minute, it being claimed that the spindle offers the advantages of sufficient power for any grinding requirement and a sufficient rotative speed to maintain the proper peripheral wheel speed in grinding small holes. The spindle is equipped with the XLO high-speed controlled ball bearing. As in the smaller non-automatic speed-control spindles made by this company, the exhaust air is circulated around the bearings to cool them.

This spindle is also applicable for grinding hob and worm threads, male or female centers, and for driving high-speed diamond cutting tools. The spindle nose is provided with an internal taper and thread to receive wheel quills of various lengths and chucks for holding solid-stick or pencil stones, steel-insert pencil wheels, or tools of other kinds.

AUTOMATIC NUT THREADING ATTACHMENT

An attachment for threading nuts and other small parts as they are formed and cut off in automatic screw machines has been placed on the market by the Automatic Nut-Thread Corporation, 24 W. Tupper St., Buffalo, N. Y. This attachment is used in conjunction with the transfer arm of the Brown & Sharpe slotting attachment. As may be seen in the illustration, a plunger is fitted on the slotting attachment arm, and this plunger enters the blank nut as soon as it is drilled. When the nut is cut off, the transfer arm immediately swings it to the front in line with the threading attachment, which is in the same location as the usual slotting attachment head on automatic screw machines. As the transfer arm reaches the upright position, it pushes the blank nut forward into a hexagon socket or chuck which revolves around the tap. The rotating nut is automatically carried over this tap, passing through a hollow spindle and sliding out on the end of the bent tap shank.



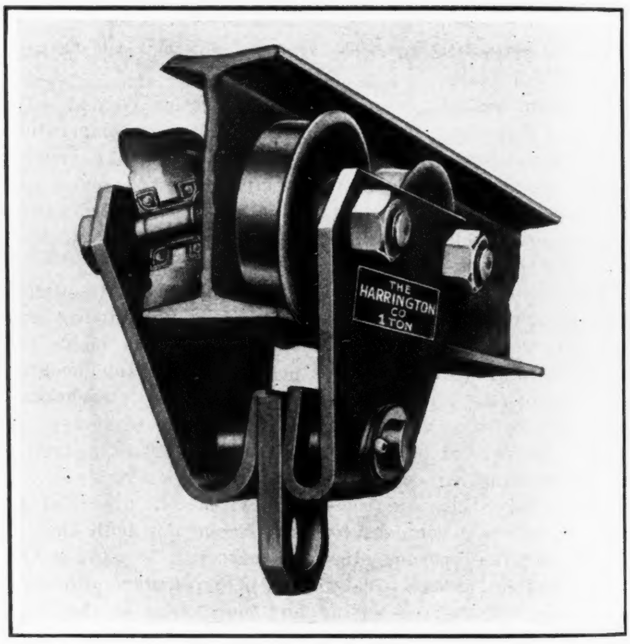
Attachment for threading Nuts on Automatic Screw Machines

The dropping of the nuts from the tap shank is so controlled by a special sleeve arrangement that the tap is always full of nuts. The tap is of the floating type, and is bent to an angle of 90 degrees. The spindle is mounted in ball bearings. This attachment is simple in construction, and the necessary adjustments are few and readily made.

It is claimed that a large saving in production costs is possible, because the attachment eliminates the sorting of nut blanks from the scrap in the pan, cleaning them, and tapping them in an independent machine. At the present time the attachment may be supplied for Brown & Sharpe Nos. 00, 0, and 2 automatic screw machines, but it will be built for use on other makes of automatic screw machines.

HARRINGTON I-BEAM TROLLEYS

Ball-bearing wheels are provided on the model D hoist trolleys made by the Harrington Co., 17th and Callowhill Sts., Philadelphia, Pa., for running on I-beams. Another



Harrington Self-aligning Ball-bearing I-beam Trolley

feature of these trolleys, in addition to the ball-bearing wheels, is the design of the frames, which are made self-aligning. The side frames are cut from heavy plate and have the lower ends bent inward to provide a support for the link pin. The sides flare out at the same angle as the beam flange, so that the turned, straight tread of the wheels bears over the full length of the face.

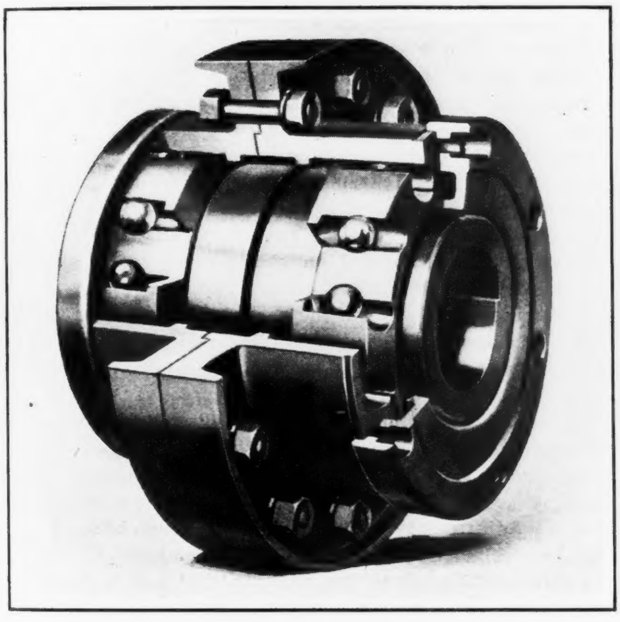
Two cup-and-cone type ball bearings are furnished in each wheel to provide easy operation of the trolley both on straight track and around curves. Because of the flexible connection between the side plates and the link pin, each of the four wheels is made to carry its proper share of the load. Spacing collars are provided between the side plates and the retaining cotter-pins, which can be moved to a position between the side plates and the supporting link to widen the trolley for use on beams larger than standard size. Six of these collars permit widening the trolley up to 3/4 inch, and special long pins and spacing collars can be furnished.

The link in the trolley may be replaced by a combination link and stud for making a permanent connection to hoist frames in a manner that permits the lifting hook of the hoist to approach more closely to the beam than is permitted by the regular hook types. This trolley is made in four sizes with ratings of 1/2, 1, 1 1/2, and 2 tons, respectively.

SYKES UNIVERSAL SHAFT COUPLING

A flexible coupling that will compensate for small errors in the alignment of shafts and that can also be used for connecting badly misaligned shafts has been placed on the market by the Farrel Foundry & Machine Co., Inc., Buffalo, N. Y. This coupling really comprises a universal joint, and has a limit of angularity of 5 degrees. It is said that it will satisfactorily connect shafts offset as much as 4 per cent of the shaft size; thus, for instance, a coupling made for a 4-inch diameter shaft will allow an offset of as much as 0.16 inch.

It will be seen from the illustration that the coupling consists of three main parts. Two of these parts are in the form of hubs, one of which is keyed on the driving shaft and the other on the driven shaft. The third part is made in halves and forms a sleeve that connects the other two parts. The actual connection, however, is by means of balls contained in grooves formed in lugs. One set of lugs is on each of the hub members, and corresponding lugs projecting inward are on the sleeve member. The balls can take a suitable position in their grooves to give a true, uniform rotation irrespective of the amount of misalignment up to the maximum. All parts are made of steel, and the balls

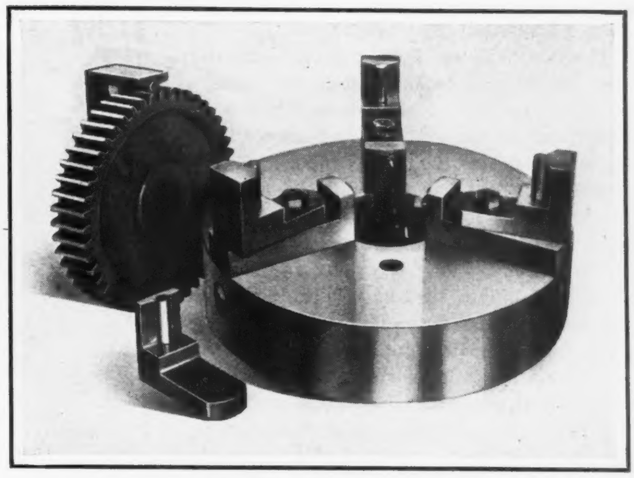


Sykes Universal Shaft Coupling

are standard hardened steel balls of the quality used in ball bearings.

It may be thought from a superficial observation that there is danger of the balls or the grooves wearing rapidly. However, the balls do not function as they do in a journal ball bearing, and if the coupling is mounted in true alignment the balls have no movement. If a coupling is operated under conditions of maximum misalignment, each ball will have a movement of only about 1/32 inch per revolution. Therefore, even under the worst circumstances, the velocity is low and the conditions of operation are more analogous to a ball bearing in a crane hook than to a journal ball bearing.

The construction of the coupling permits free axial movement of one shaft relative to the other, and so the coupling may be used for connecting electric motors to driven shafts, because it permits axial movement of the armature without appreciable resistance. Owing to the use of balls as the power transmitting medium, the question of lubricant is not important. The balls have such a slight movement that a film of grease furnishes ample lubrication. The coupling is at present manufactured for shafts from 3/4 to 8 inches in diameter, but larger sizes are to be placed on the market later. The 8-inch coupling will transmit 1200 horsepower per 100 revolutions per minute.



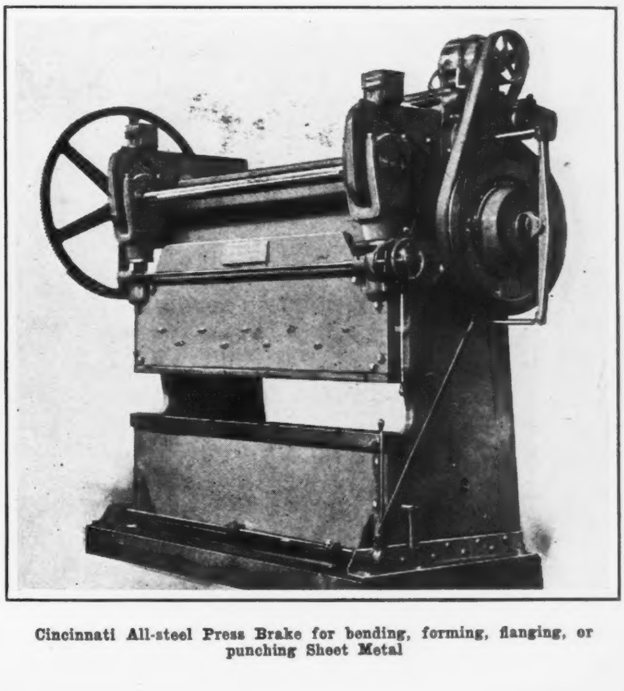
Skinner Chuck designed for holding Gears at the Pitch Line

SKINNER GEAR CHUCK

An improved gear chuck recently developed by the Skinner Chuck Co., New Britain, Conn., is shown in the accompanying illustration. This chuck is of the three-jaw universal type, and is made with a heavy body, rack, and pinions. Two-piece jaws are used, the top half being adapted to holding gears on the pitch line. These jaws are adjustable so that it is possible to hold gears of either an even or an odd number of teeth. The chuck can be made dustproof to insure that in grinding the bore of hardened gears, no dust can penetrate into the working parts of the chuck and cause undue wear. Chucks can be built in a range of sizes to accommodate gears from 3 to 42 inches in diameter.

CINCINNATI ALL-STEEL PRESS BRAKE

An all-steel press brake of smaller dimensions than the one brought out several years ago by the Cincinnati Shaper Co., Elam St. and Garrard Ave., Cincinnati, Ohio, which was described in October, 1922, MACHINERY, has recently been developed by the same company. This new machine may be used for bending, forming, flanging, or punching sheet metal for a large variety of work, such as office equipment, steel lockers, shelving, building trim, stairs, skylights, sash, and automobile or truck bodies. The brake is constructed of rolled steel plate in such a manner as to reduce to a minimum any trouble arising from carelessness or accident. Among the advantages claimed is the elimination of deflection in making bends. Also, there is no limitation on



Cincinnati All-steel Press Brake for bending, forming, flanging, or punching Sheet Metal

the width of the material that can be handled, because of the open throat.

The two housings are cut from 3-inch solid steel plate and finished to a thickness of 2 3/4 inches. The ram and the bed are also cut from similar plate, and have heavy angles welded to them to furnish additional stiffness. The top of the bed is made from a steel billet machined to the shape of a saddle and welded to the main plate. All gears, including the large one, are made of steel, and double keys of the Kennedy type are used throughout. The screws are cut from a high-carbon, high-nickel steel with a buttress thread. There is a worm and worm-wheel adjustment to the screw, which may be made either by hand or power.

The clutch is of a multiple-disk type provided with asbestos material on the friction surfaces. Ball bearings are furnished for the flywheel, the idler pulley of the motor drive, and the worm adjustment to the ram. The adjustment and its power-elevating device run in oil, and all other parts not lubricated in this manner are automatically oiled from two stations on top of the housings. The control of the machine is accomplished either by means of the foot-treadle or the hand-lever, both of which can be moved to any position across the front of the machine. Stopping of the machine immediately upon releasing the clutch, is accomplished by means of a brake.

This series 70 press brake has a stroke of 3 inches, an adjustment of 5 inches, and a throat clearance from the center of the dies, of 8 inches. It runs 30 strokes per minute, and can be built in any length between housings from 4 feet 6 inches to 10 feet 6 inches. There is sufficient capacity for making right-angle bends, continuously and at one stroke, in No. 10 gage steel sheets 10 feet long, over a 1 1/8-inch die, to a radius equal to the thickness of the metal. Either a belt or motor drive can be supplied.

BRYANT NIPPLE THREADING MACHINES

An automatic machine for threading nipples, tubing, etc., which is built by O. Bryant Sons & Co., 366 Ontario St., Buffalo, N. Y., is shown in Fig. 1. Right- or left-hand straight threads and pipe threads can be cut simultaneously on both ends of the work, and the threads can be continued until they almost meet. Pipe up to the 3-inch size and up to 9 inches long can be handled, while threads can be cut on the ends to a length of 2 inches. The smallest size of pipe that can be threaded is the 1-inch size. This machine is primarily intended for use in radiator manufacturing plants, but it is also applicable in other fields.

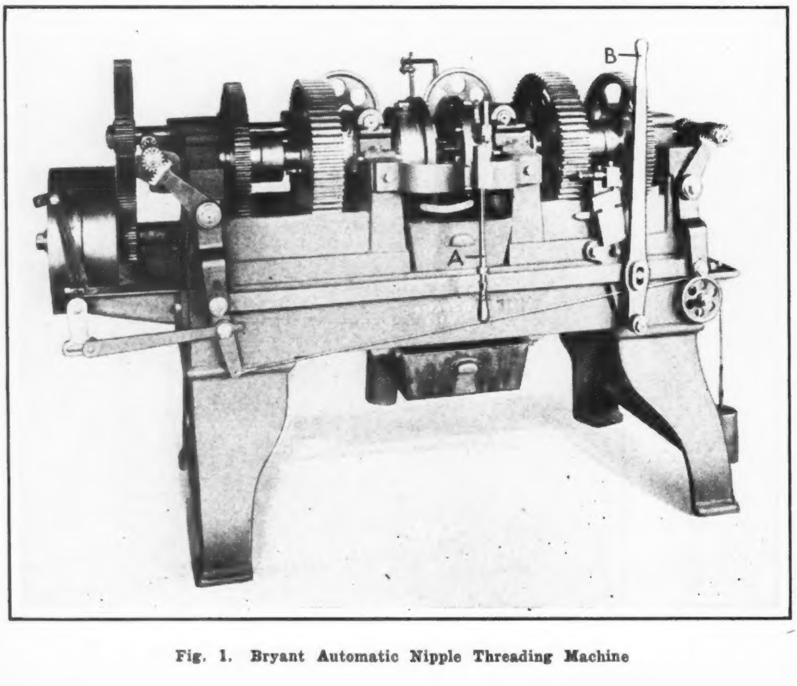


Fig. 1. Bryant Automatic Nipple Threading Machine

A tight and loose pulley drive is provided, power being delivered from the tight pulley through reduction gearing to a shaft running along the back of the machine. On this shaft there are four pinions, two of which drive the two narrow-faced gears located on shafts on opposite sides of the work. On these shafts there are two sets of cams which feed the die-heads toward the work at the center of the machine as the gears rotate. At the end of an operation, the die-heads are returned to the starting position by weights holding the cam sets in engagement.

The other two pinions on the rear shaft drive the wide-face gears which are mounted on sleeves on the same shafts as the gears that produce the feed of the die-heads. These wide-face gears drive the work, as the die-heads do not revolve. Adjustments of the die-heads longitudinally are made to accommodate work of different lengths.

In placing the work in the machine, it is laid between the fingers of lever *A*, which is then lifted to lower the work into line with the center of the die-heads. Lever *B* is next operated, causing plugs to enter into the ends of the work and hold it for the operation, the machine being started at the same time. Automatic disengagement of the drive occurs at the completion of the operation, and the work is automatically released. A production of about 160 nipples per hour is claimed for the machine.

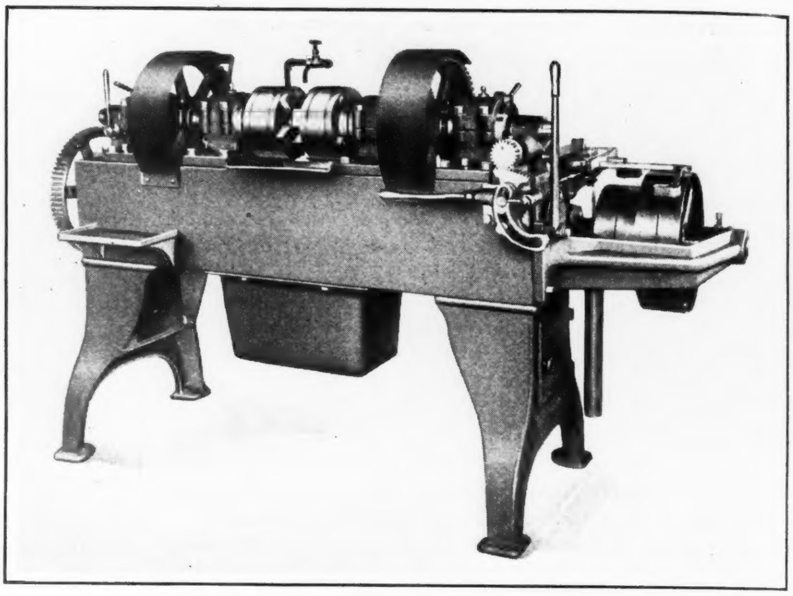
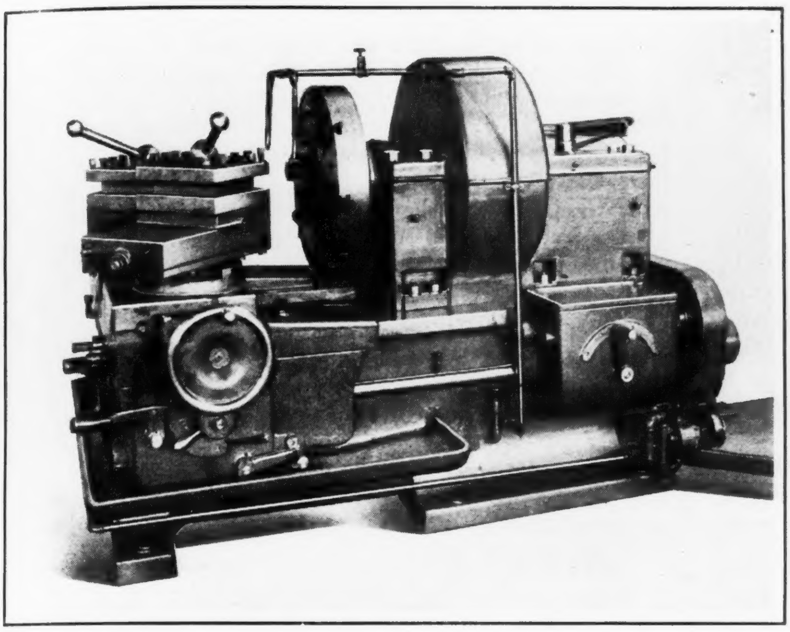


Fig. 2. Plain Type of Nipple Threading Machine

Fig. 2 shows a machine of somewhat similar design, but in this type, the die-heads both revolve and feed longitudinally. This machine receives pipe from 1 to 2 inches, and has a capacity for threading about ninety nipples per hour.

BETTS-BRIDGEFORD BEVEL-GEAR TURNING LATHE

A lathe designed primarily for turning the face and back angles of heavy bevel gears made of alloy steel has recently been placed on the market by the Betts Works of the Consolidated Machine Tool Corporation of America, Rochester, N. Y. This lathe follows the general design of similar ma-



Betts-Bridgeford Heavy-duty Lathe built for turning Large Bevel Gears

chines built by this company, except that it is much heavier throughout and has a number of important improvements. The bed is only about 6 feet long, and is made of a heavy box section with broad flat ways. On the bed is mounted a carriage having two independent cross-slides which can be quickly and securely clamped. Each cross-slide supports a swivel tool-slide provided with square guides, and each tool-slide carries a revolving four-way steel turret toolpost on which four tools can be mounted at one time. These tool-slides are so designed as to permit taking heavy cuts in tough material.

Each side of the machine is equipped with an independent feed-box which furnishes four feeds for the tool-slides, and so it is possible to use different feeds for each slide. Both aprons are double-wall one-piece castings, and carry a positive trip-feed mechanism which is so arranged that the feed can be instantly disengaged when the tool gets to the end of the cut, by applying a slight pressure on the feed-trip lever.

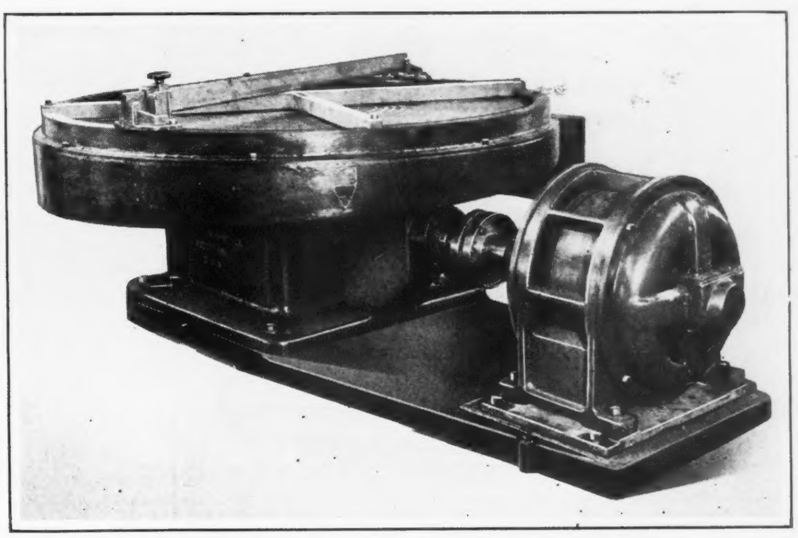
A 25- or 35-horsepower adjustable-speed motor is mounted on a floor-plate and connected to the driving shaft through spur gears. In connection with the two speed changes in the machine, the adjustable-speed motor gives a wide range of cutting speeds. The gear blanks to be machined may either be carried in a chuck, such as shown in the illustration, or mounted directly on the spindle by means of an adapter. Both the face and back angles of the gears can be machined simultaneously. The machine illustrated has a swing of 31 inches over the bed and of 22 inches over the carriage, while the tool-slides have a travel of 8 1/2 inches in all directions.

GARDNER VERTICAL-SPINDLE DISK GRINDER

There has recently been developed by the Gardner Machine Co., Beloit, Wis., a vertical-spindle disk grinder equipped with a 72-inch disk wheel, which is believed by the builder to be the largest grinding member ever mounted on a machine of this type. The machine was developed to handle numerous large flat-surface jobs, and is in effect an enlargement of the 53-inch Gardner grinder, although it embodies several new features. The steel disk wheel is 1 1/8 inches thick, and is reinforced by a 40-inch steel plate, 1 inch thick, which provides ample support well out toward the edge of the large wheel. The driving spindle is of large diameter, and runs in two self-aligning radial ball bearings, while all down or end thrust is taken on a self-aligning ball-thrust bearing which contains 1 7/16-inch diameter steel balls, and is rated to carry a load of 10,400 pounds. Power is transmitted to the disk wheel by means of hardened steel bevel gears which are fully enclosed within the machine base and provided with ample lubrication.

As may be seen in the illustration, a dust channel is cast into the base, there being a series of ports equally spaced around the outer circumference and opening into this dust channel. A cast-iron guard ring is fastened to the top of the base, but any portion of this ring may be removed to permit the grinding of work having a lug projecting above the plane of the ground surface. Work-holders of any required type may be secured to this ring. Either a belt or motor drive can be furnished, but the grinder is particularly adapted to a direct-connected motor drive. The machine occupies an operating floor space of 12 by 12 feet.

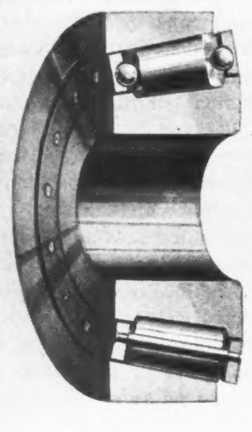
One of the important features of this equipment is a special pneumatic press, which is furnished with it. This press is made of sheet steel, formed into an oval shape on top and with a thin sheet-metal diaphragm welded across the bottom. After the steel wheel and the back of the abrasive disk have been coated with cement and placed together, this press is put on top of the whole, and with numerous malleable iron clamps, is fastened firmly to the outer edge of the disk wheel. Air is then pumped into the cone until the gage shows a pressure of about 5 to 7 pounds. This pressure is equivalent to 14 tons on the entire surface of the wheel.



Gardner Vertical-spindle Disk Grinder equipped with 72-inch Wheel

VERVOORT ROLLER BEARINGS

In a line of straight and taper roller bearings being introduced to the trade by the Vervoort Roller Bearing Co., 174-178 Hopkins Ave., Jamestown, N. Y., the basic design involves a combination of rollers and balls. From Fig. 1, which shows a type A taper roller bearing, it will be seen that a ball is placed between a cup-shaped hollow in the outer ends of each roller and an elongated slot in the adjacent flange. Stay-rods are located between the rollers to connect the two flanges, and these stay-rods hold the rollers in place so that the balls prevent the ends of the rollers from contacting with the flanges. This construction makes



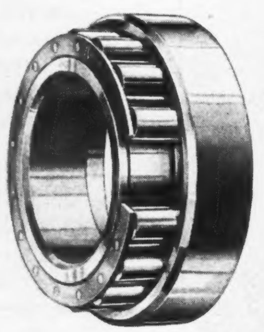


Fig. 1. Vervoort Taper Roller Bearing

Fig. 2. Type G Annular Roller Bearing

the rollers full-floating and is said to eliminate friction, binding in the housing, or breakage of the retainer.

The inner cone of the type A bearing is made with two shoulders, and the retainer is not removable. On another taper roller bearing known as type B, the inner cone is provided with only one shoulder. The retainer of this bearing is removable, and at the same time the rollers and balls remain assembled in the retainer. In a type C taper roller bearing, the inner cone is equipped with rings instead of having shoulders. The retainer cannot be removed from this cone.

Long bearings are made with straight rollers for such applications as Ford wheels and drive shafts. These type D and M bearings can be furnished with a split cage for installation on lineshafts. Fig. 3 illustrates two type K long roller bearings which can be made up with either two or three series of rollers and one or two intermediate flanges, respectively. This type of bearing is intended for use with lineshafts or in hoists and cranes, etc. The construction is said to eliminate any breakage of the case under a heavy load at high speed and crystallizing of the rollers. This bearing can also be furnished with a split retainer to make possible its installation without removing shaft hangers.

The type L roller bearing is similar to the type K, except that there are no flanges between the series of rollers. The rollers of this bearing are coupled together by means of balls mounted in the outer ends of the rollers, the latter being cupped in the ends to a depth corresponding to the size of balls used. To prevent the wearing of a shoulder on the shaft or sleeve on which the bearing is mounted, the roller are staggered as to length.

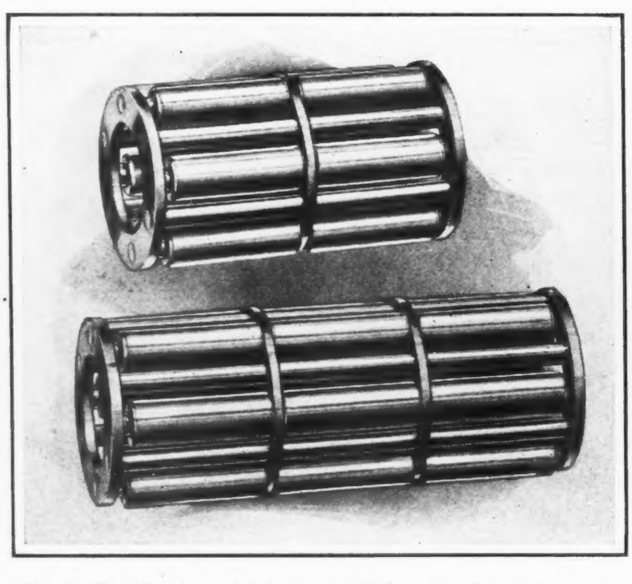
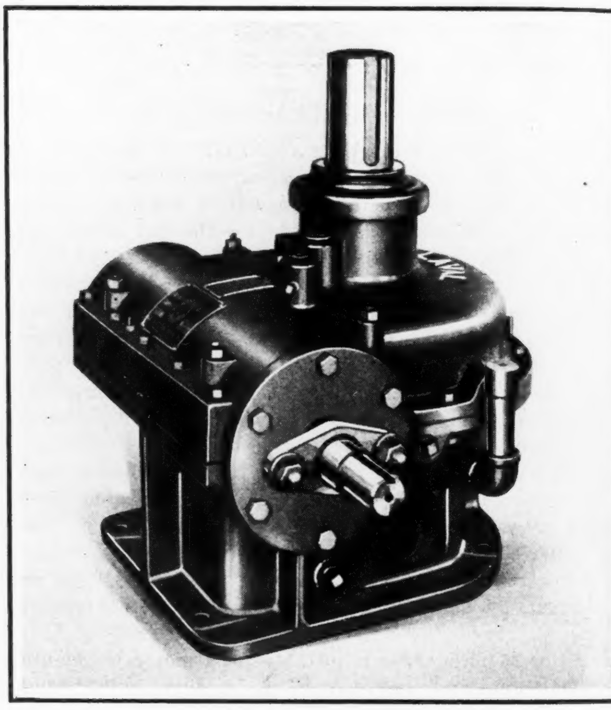


Fig. 3. Long Bearings with Series of Rollers and Intermediate Flanges

The type G annular roller bearings shown in Fig. 2 are made in all standard sizes. The rollers are mounted between two shoulders on the cone. Another annular type bearing designated as type H is made, in which the retainer is mounted in a simpler form and is removable from the cone. The rollers run freely on the surface of the cone, and the retainer guides itself on the outer end. Type H is considered by the manufacturer to be superior to type G.

DE LAVAL WORM REDUCTION GEAR

A worm reduction gear for a vertical shaft drive, which has recently been developed by the De Laval Steam Turbine Co., Trenton, N. J., is shown in the accompanying illustration. The casing of this equipment supports the worm bearings and also the lower bearing of the driven shaft, the upper shaft bearing being held by the casing cover. Oil is carried at such a level that the worm and worm-wheel dip into it, thus insuring copious lubrication. The lower wheel-



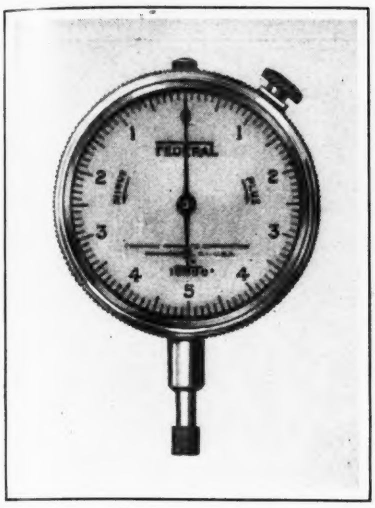
De Laval Reduction Gear for Vertical Shaft Drive

shaft bearing is always immersed in oil and has spiral grooves to insure oil circulation.

To provide oil for the upper wheel bearing and thrust plate, a small reciprocating oil-pump is incorporated in the casing cover. The plunger of this pump projects downward against a cam, the rotation of which actuates the plunger. By means of ball check valves, the plunger draws in oil through a suction pipe that projects from the under surface of the cover down into the oil in the casing. Filling and drainage openings, together with a try-cock, provide for controlling the oil level. Inspection of the amount of oil at long intervals is said to be about the only attention required of the equipment. With the larger sized reductions a positive pressure oiling system is used to feed oil to all bearings and to the worm threads and gear teeth at the contact points. A full line of these drives is made with the shaft extending either upward or downward.

FEDERAL DIAL INDICATOR

A model 30 dial indicator which is graduated to 0.0001 inch has just been brought out by the Federal Products Corporation, Providence, R. I. The feature claimed for this instrument is that one complete revolution of the dial hand represents only a 0.010 inch movement of the spindle. While



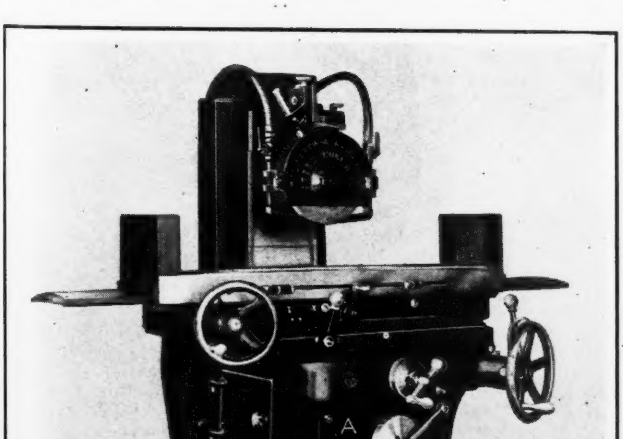
Federal Dial Indicator

the dial illustrated reads 0-5-0, a dial can be furnished to read 0-10. The standard range is 0.020 inch, or two complete revolutions of the hand, but when the indicator is desired for comparative work only and extreme accuracy is not essential, a range of 0.200 inch can be provided, which corresponds to twenty complete revolutions of the hand. The indicator is 2 7/32 inches in diameter, and has a bezel clamp for locking the dial.

WILMARTH & MORMAN SURFACE GRINDER

Several improvements have recently been incorporated in the construction of the No. 78 "Super" surface grinder built by the Wilmarth & Morman Co., Grand Rapids, Mich. All mechanisms, such as the clutch, gear-box, and worm drive, are now accessible by removing plate *A* from the front of the machine. This arrangement does away with the necessity of lifting off the saddle and table, as was formerly required when access to these units was desired. All parts can now be reached for oiling and maintenance through doors and openings conveniently located in the frame.

The motor is located in the base and connected to the drive spindle by means of a flexible coupling. The motor is accessible from both sides of the machine, and the drive spindle is equipped with ball bearings. Still another improvement is in the clutch, which is made of hardened steel and travels on ball bearings on a hardened steel shaft, the balls acting as a key for driving the clutch. It is claimed that the free action of this clutch eliminates jars when the table travel is reversed, the clutch will not "slip up" prematurely or stop on center.

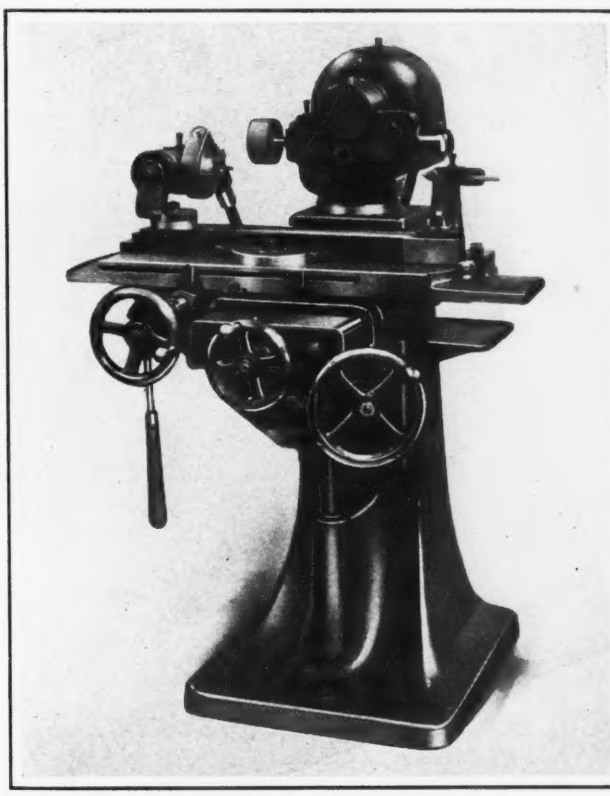


Wilmarth & Morman Improved Surface Grinder

Roller and ball bearings have replaced, to a large extent, the bronze bearings formerly provided. The main spindle is equipped with special deep-groove ball bearings which are arranged with an automatic take-up in combination with an adjustable take-up. There is a direct flow of the water or coolant from the saddle to the coolant tank, the latter being placed on the outside of the machine so that it can be easily removed and looked after.

OESTERLEIN MOTOR-DRIVEN CUTTER AND TOOL GRINDER

An individual motor drive has recently been applied to the No. 2 universal cutter and tool grinder built by the Oesterlein Machine Co., Cincinnati, Ohio. As here illustrated, the motor is mounted on the wheel-head and is entirely enclosed. It drives the wheel-spindle through a flexible coupling and a pair of spiral gears, the driven gear being mounted directly on the spindle. Ball bearings are used throughout the head construction, and there are two



Oesterlein Motor-driven Universal Cutter and Tool Grinder

bearings on the driving gear and four on the spindle. The spiral gears run in oil. Any standard 3/4-horsepower motor running at 1800 revolutions per minute can be used.

The wheel-spindle head may be swiveled on its graduated base to 90 degrees in either direction, and locked in any position. It is thus possible either to use a plain wheel for cylindrical grinding or to place the wheel-spindle at right angles to the table for using a cup-wheel in cutter and tool grinding. This and other details of the machine are the same as on the belt-driven machine described in April MACHINERY. The same equipment used for tool, cylindrical, internal, and surface grinding on the belt-driven machine may also be used on the motor-driven machine, and any belt-driven No. 2 machine now in use may be adapted for individual motor drive.

BRUBAKER SPIRAL INSERTED-BLADE REAMERS

A line of spiral-fluted reamers made up with inserted high-speed steel blades has recently been developed by W. L. Brubaker & Bros. Co., Millersburg, Pa. These reamers have

Gear
Service

BROWN &

Gears?

Send for this booklet

The Brown & Sharpe Mfg. Co., has just issued a new booklet, "Gear Service."

It tells about the "Service"—of our long, active experience and complete modern facilities to assist customers in the solution of gear problems.

It tells about our facilities for producing all types of gears.

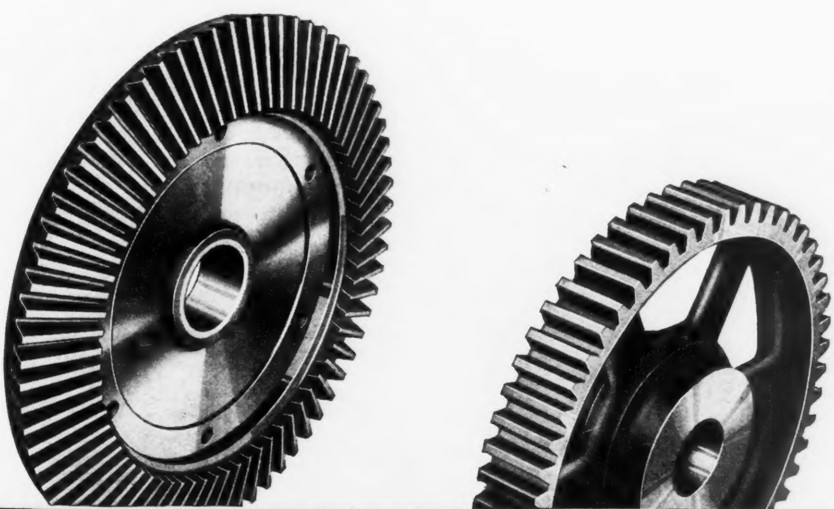
It contains a considerable amount of Gear Data—formulas, rules and other valuable information.

It is free to all users of gears.

Send in the coupon today.

Brown & Sharpe Mfg. Co. Providence, R.I., U.S.A.

MEMBER OF AGMA



SHARPE

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Brown & Sharpe
Mfg. Co.
Providence, R. I., U. S. A.

I am interested in good gears, their manufacture and your Service.

Kindly send me a copy of "Gear Service"—your new booklet.

Name....................................

Address....................................

M-11-25

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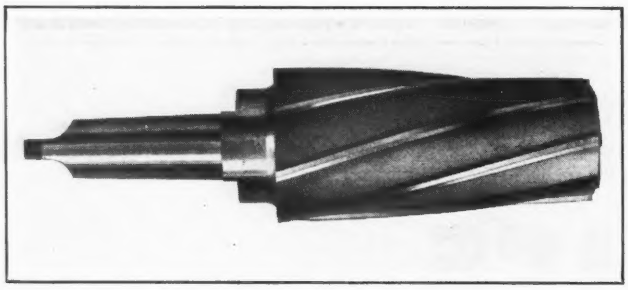


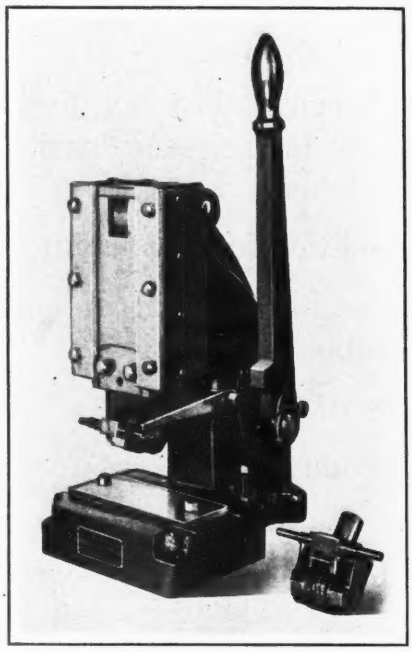
Brubaker Spiral Reamer with Inserted High-speed Steel Blades

the advantages of a solid high-speed reamer at a great saving in cost. The body of the reamers is made of a steel that gives toughness and strength to the tools. The blades are given a heat-treatment to insure them against breakage and give them the proper hardness and durability. These reamers can be furnished in various diameters from 2 to 10 inches, and in different lengths. They can be furnished in all the standard tapers.

NOBLE & WESTBROOK NUMBERING PRESS

A press particularly designed for use in connection with numbering machines for numbering metal plates or parts is made by the Noble & Westbrook Mfg. Co., Hartford, Conn. It is intended that a numbering head be kept in the press at all times for use as the occasion requires. This is economical, it is stated, because the press is inexpensive and the practice eliminates the changing of set-ups. Consecutive serial numbers can be stamped automatically at each stroke of the handle, or the same number can be stamped indefinitely.

Power is applied through the handle by a lever having a toggle-joint movement, which gives a smooth action. The ram is heavy and is equipped with a gib to take up wear. The numbering heads are made to order with any number of wheels from two upward, and of any required size. This machine is also suitable for such work as light blanking, stamping, or lettering.



Noble & Westbrook Numbering Press

BIGNALL & KEELER PIPE THREADING AND CUTTING MACHINE

A duplex pipe threading and cutting machine which handles pipe from 10 to 20 inches, inclusive, is a recent development of the Bignall & Keeler Machine Works of the N. O. Nelson Mfg. Co., Edwardsville, Ill. The machine is equipped with a single-pulley drive, all speed changes being obtained through steel gears running in oil in a box that is part of the bed. While the illustration shows the machine arranged for a belt drive, a motor drive can be easily furnished by mounting a 10-horsepower constant-speed motor above the machine and connecting through reducing gears and a silent chain.

Only one die-head is required for all sizes of pipe, and no special tools are necessary for changing the dies. The dies are of the Peerless skip-tooth type, 3 7/16 inches wide, and there are twelve pieces per set; they have a curved eccentric relief. Tools are also furnished for cutting off, reaming, and beveling pipe. The lubricating system includes a reversible geared oil-pump, piping, and control valves. A three-jaw independent chuck is furnished on each end of the arbor. The rear chuck has flange grippers for use in making up or breaking down flanged fittings. The front chuck is located close to the housing and is bolted securely to the master gear. The machine weighs 26,500 pounds.

MOLYBDENUM STEEL BALLS

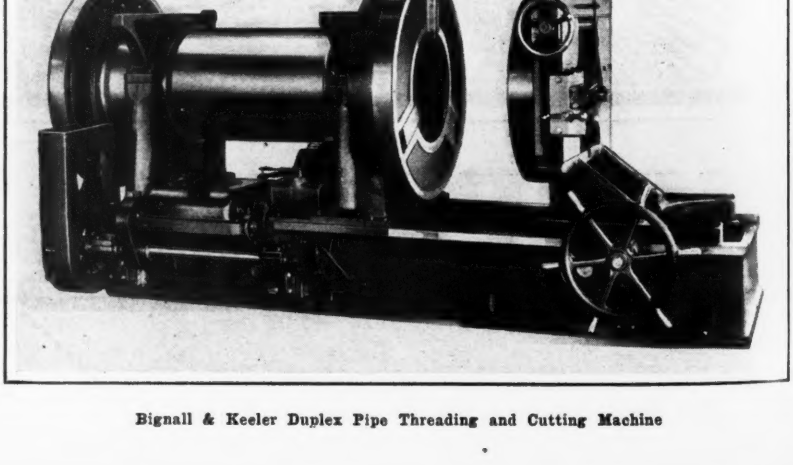
It has been announced by the Standard Steel and Bearings, Inc., Plainville, Conn., that in the future bearings made by this company will be provided with chrome-molybdenum electric furnace steel balls for sizes of balls 1 inch in diameter or larger. It is claimed that these balls have an increased toughness and breaking strength, and greater and more uniform hardness, and hence greater load-carrying capacity and greater endurance than the former chrome alloy steel balls. The reason why only balls of 1-inch diameter and larger are made from molybdenum steel is that the demand for greater capacity in ball bearings has in the past been limited generally to the larger sizes.

HISEY ELECTRIC DRILL

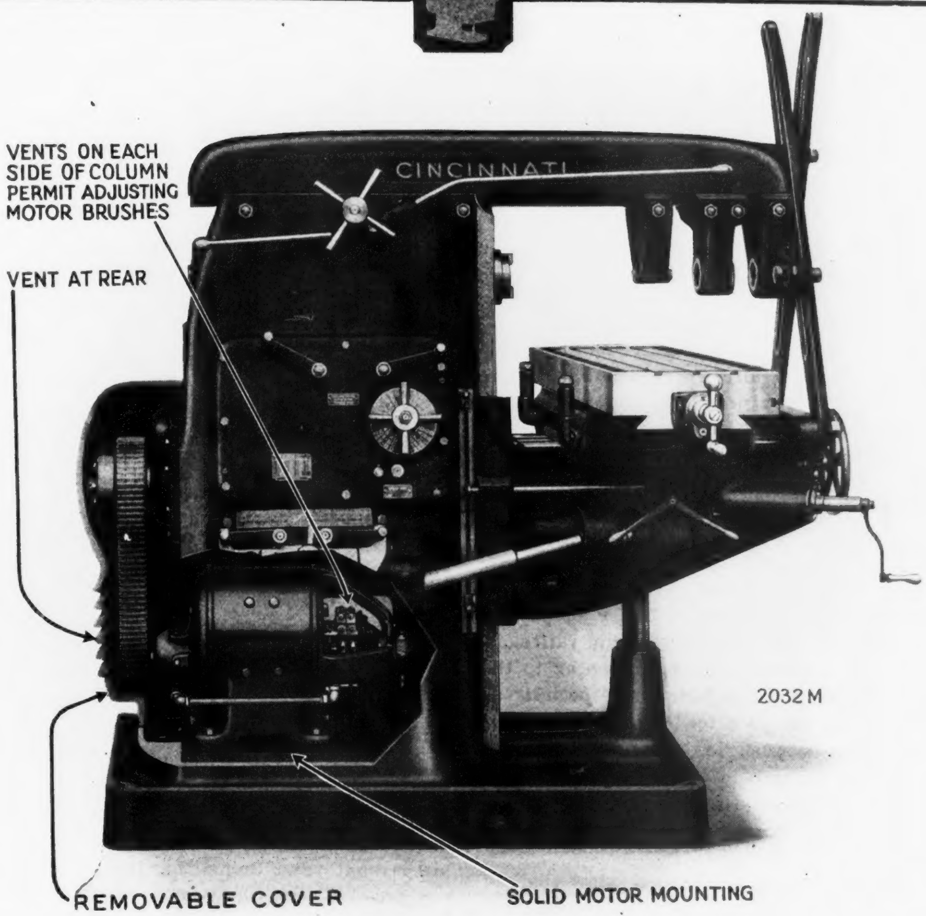
The latest addition to the line of portable electric tools manufactured by the Hisey-Wolf Machine Co., Cincinnati, Ohio, consists of a universal-motor drill having a capacity for drilling a 5/8-inch hole through steel. In construction, this drill follows closely the 1/2-inch size described in June MACHINERY. It can be furnished with a chuck or a No. 1 or 2 Morse taper socket. The speed under no load is 500 revolutions per minute, and the weight is 21 pounds.

SYRACUSE BELT GRINDER AND SANDER

In the article published on page 170 of October MACHINERY relative to the new Syracuse belt grinder and sander built by the Porter-Cable Machine Co., Syracuse, N. Y., an erroneous statement was made in referring to a 150-pound weight. It was mentioned that a 150-pound weight placed on the end of the bed, when the bed is in the horizontal position, prevents an unbolted machine from tipping over. It was intended to give an idea of the stability of the machine, and the sentence should have stated that even if a weight of 150 pounds were placed on the outer edge of the bed when horizontal, an unbolted machine would not tip over.



Bignall & Keeler Duplex Pipe Threading and Cutting Machine



HERE'S ANOTHER GOOD FEATURE

ON THE NEW PYRAMID COLUMN CINCINNATI MILLERS

Not Talking Points But Productive Features

1. Tapered Roller Bearings
2. Automatic Oiling in Column
3. Centralized Oiling
4. Pyramid Column
5. Power Rapid Traverse
6. Rear Control
7. Sliding Gear Transmission
8. Multiple Disc Clutch Running in Oil
9. Double Starting Levers
10. Rectangular Overarm
11. Spindle Brake
12. Spindle Reverse
13. Standardized Spindle End
14. No. 14 Taper Hole in Spindle

CINCINNATI
MAKES MORE MACHINE TOOLS, IN LARGER VARIETY, THAN ANY OTHER CITY IN THE WORLD.
TO SEE ANY UP-TO-DATE MACHINE TOOL COME TO
CINCINNATI

The Enclosed Motor Drive

An *enclosed motor drive* is provided within the column. The column is interchangeable for overhead belt and enclosed motor drive and the change can be made at any time. The motor is bolted to a flat plate machined on both sides which in turn is positively secured to the strong box section base of the machine by heavy bolts. This arrangement gives a solid motor mounting and eliminates vibration.

The drive from the motor to the drive shaft is by means of a silent chain. Ample ventilation is secured through vents in the sides of the column and the rear cover of the motor compartment. Provision is made for easily and quickly oiling the motor and adjusting the brushes through the vent holes, the covers of which lift off without loosening the screws. It is a very easy matter, when necessary, to remove the motor. Replacing and realigning the motor are just as easy.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI·OHIO·U·S·A·

"MODERN EQUIPMENT IS PROFIT ASSURANCE"

CINCINNATI MILLERS

THE AUTOMOTIVE INDUSTRY AND THE RAILROADS

In a comprehensive address entitled "American Transportation," covering the fundamental railroad problems of the present, delivered at the regional meeting of the American Society of Mechanical Engineers, at Altoona, Pa., Samuel Rea, past president of the Pennsylvania Railroad Co., briefly discussed the relation between the railroads and other passenger and freight carriers.

"No one can be more willing than myself to recognize the advent of other forms of transportation or to appraise liberally their value and importance," said Mr. Rea. "I am, however, profoundly convinced that their eventual effect will be greatly to increase, and in no sense diminish, the vital importance of, and necessity for, railroads. Motor transportation, it is quite true, has already required extensive changes in railroad methods and practices, and in conjunction with air transport may not improbably bring about still further changes of important character. It is, however, my firm belief that, as the basic carriers of the nation, the railroads will indefinitely retain the position of fundamental supremacy and importance.

"As a railroad man, I have not the slightest fear in admitting that for many purposes motor cars are capable of furnishing short-distance transportation to better advantage, and with greater economy and efficiency, than railroads. However, the country as a whole, I think, is coming to the realization that the motor car's true function, especially as a commercial carrier, is chiefly as a feeder of the railroads and as a connecting link between the existing rail lines. Save in rare instances, it is, and must indefinitely remain, a far less efficient, less satisfactory, and less economical instrument than the railroads for long-distance or bulk transportation of either passengers or freight.

"Incidentally, I wish to express the further view that, in the long run, motor cars, through the vastly increased business activity that they have brought about in so many directions, will create for the railroads much more new traffic than they will ever by any possibility take away through direct competition. Indeed, they have been doing this ever since they became an important influence in the manufacturing and transportation fields. The real problem as between railroads and motor cars is not one of competition but of coordination, to the end that each of these agencies of transportation may be free to develop and progress in its proper field, and in that manner best serve the public needs.

"Air transport is still largely an unknown quantity. If I were to hazard a guess, however, it would be that its commercial development, as an agency of passenger service will, for at least a long time in the future, be confined to very high grade de-luxe transportation for people willing to pay necessarily high rates in return for exceptional speed, the saving in time and the novelty and distinction of a mode of travel open only to the few.

"As a carrier of goods, air transport is quite likely to develop, on a considerable scale, in the field of high-class mail and express, and perhaps certain forms of very valuable freight. In all of these respects, it seems to promise the creation of a new super-luxurious transport field of its own rather than to threaten a very serious invasion of the fields already occupied by the railroads. Nor should we lose sight of the fact, which is now pretty clearly established by the experience in Europe today, that in the stage of evolution now reached or in sight, extensive air transport is, at present, only possible on a commercial basis when aided by government subsidies or guaranties.

"Incidentally, I expect to see the last vestiges of commercial traffic on inland canals disappear from the United States, and all fanciful projects for canalizing rivers not naturally navigable relegated to oblivion. In a nation so plentifully supplied with railroads with their exceptionally cheap rates, for the service rendered, having practically a motor car for every family, and holding the pioneer honors in the art of flying, such a slow, cumbersome, easily interrupted, expensive and inefficient method of transportation as is afforded by artificially constructed and maintained inland waterways—often closed for half the year by climatic conditions—can no longer have a real place."

* * *

HIGH-SPEED CUTTING OF BRASS

In discussing the paper "High-speed Cutting of Brass," read by Luther D. Burlingame, of the Brown & Sharpe Mfg. Co., at the technical meeting held in conjunction with the New Haven Machine Tool Exhibition in September, John L. Christie, metallurgist of the Bridgeport Brass Co., pointed out that different methods of manufacture sometimes require different kinds of brass rod for producing the same parts. For example, there are instances on record where two different screw products concerns making the same part for the same customer require different rods because of the different set-ups of the machines. One was able to use the standard rod shipped from stock, while the other demanded a rod of special properties.

Mr. Christie also called attention to the fact that the term "hard" as applied to brass rod has a different meaning to the manufacturer and to the user. The same, of course, applies to the term "soft." To the user, the term "hard," applied to brass rod, means that it is difficult to cut; the term "soft" means that it is easy to cut. To the manufacturer, the term "hard" means high tensile strength, stiffness, and high Brinell, scleroscope, and Rockwell hardness numbers, and does not necessarily mean that the rod is difficult to cut. The manufacturer uses the words "free-cutting" and "not free-cutting" to describe the cutting qualities.

In steel and iron, metal that has high strength and Brinell hardness is, in general, not free-cutting, and metal that has low strength and Brinell hardness is free-cutting. In brass, the same relation does not necessarily hold. In brass, the most important factor in determining free-cutting properties is the lead content. This should be maintained at about 3 per cent; if it runs much above this, trouble will be experienced in manufacture, and in the rod itself, due to lack of strength; if it runs below 3 per cent, the maximum free-cutting properties will not be attained. The difference in lead content explains why brass rod made abroad does not cut so readily as similar stock made in this country. It also explains why tubing as a rule is "harder" (in the meaning of the user) than brass rod. If the lead content of brass tubing is higher than about 1 per cent, difficulty is met with in manufacture. The hardness (strength, stiffness, etc.) of brass is controlled largely by the amount that it is drawn, either from the extruded size or after the last annealing. This has comparatively little to do with the free-cutting properties of the rod. The rod should be drawn stiff enough so that the cutting tools will not push it out of shape. The best results, of course, are obtained by accurate control of the composition and processing of the rod.

An interesting example of the difference in meaning of the word "hard" to the manufacturer and to the user of brass rod occurred a few years ago. A customer of the Bridgeport Brass Co. and a large user of brass rod complained that he was having trouble on one particular size of rod. He stated that the rod was hard, was dulling tools, breaking drills, and generally unsatisfactory. An investigation showed that a drilling operation was being performed at the same time that a wide, heavy forming cut was being made from the side. The forming cut was so heavy that the piece was actually being bent out of line with the remainder of the rod. This caused the axis of the end of the piece to move in a circle, thus snapping the drills, dulling the tools, and breaking the rod. It was found that by giving the customer a rod which had been drawn stiffer—in other words, which was harder, according to the point of view of the manufacturer—the trouble was eliminated and the customer well pleased. In this case a rod that was claimed to be too hard was really not hard enough.

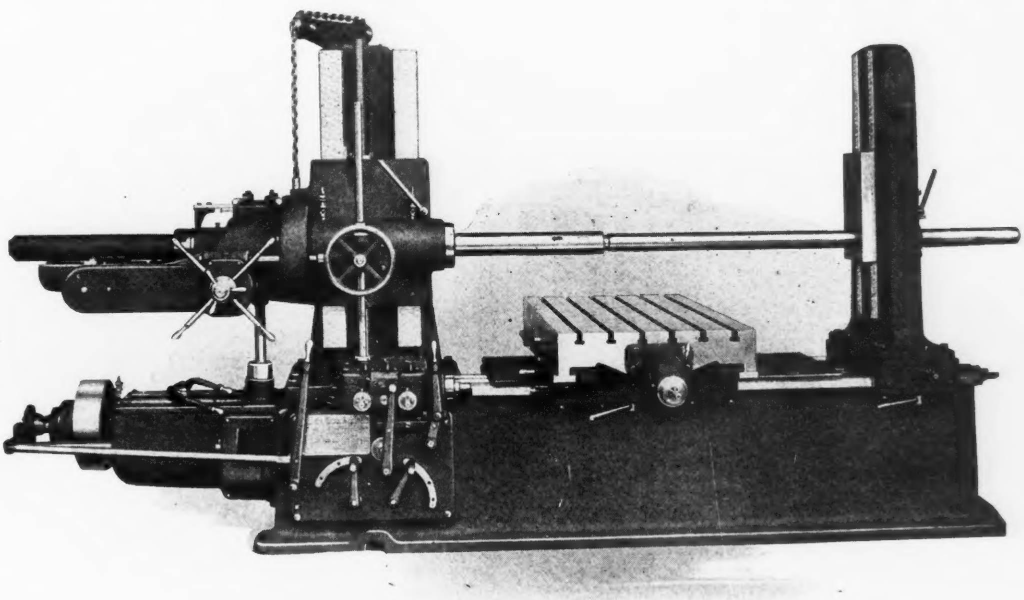
Assure profits by reducing labor turnover

Because of its accuracy, dependability, convenience and accident-proof features, operators like to run

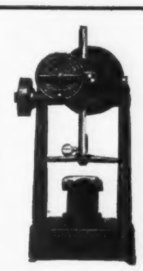
The LUCAS

"PRECISION"

Boring, Drilling and Milling Machine



We also make the LUCAS Power Forcing Press



The belt does the work.
Mechanical power is cheaper than human muscular energy.

THE LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

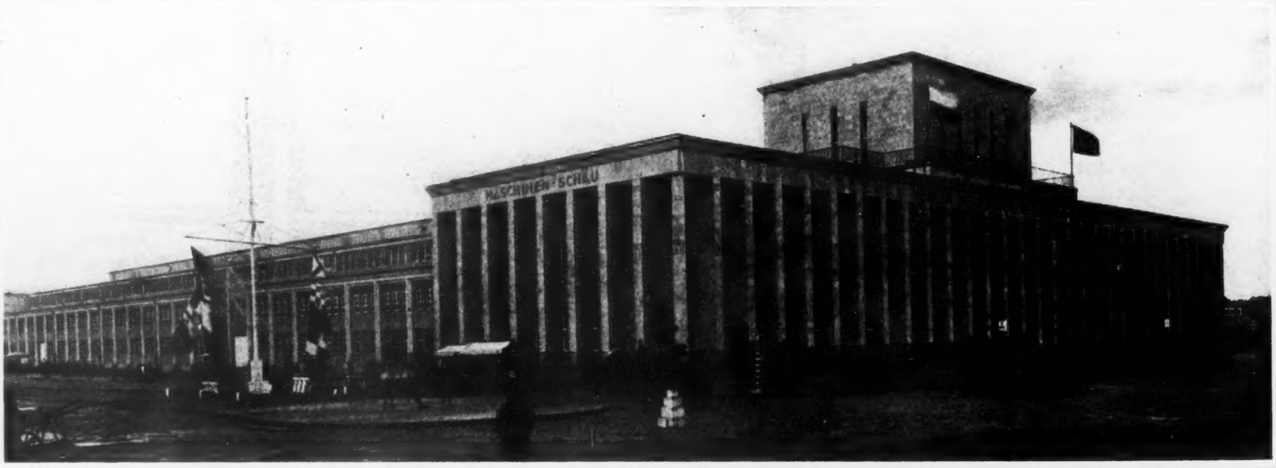
FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam, Andrews & George Co., Tokyo.

OBITUARIES

W. R. FORTNEY, Chicago representative of the Landis Tool Co., Waynesboro, Pa., and C. O. BARRIE, superintendent of equipment and maintenance of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., were killed in an automobile accident on September 28. Mr. Fortney and Mr. Barrie were driving from the Allis-Chalmers plant in Milwaukee to the Worthington plant at Cudahy and were struck by the Chicago and Milwaukee express. Both men were removed to the hospital in Milwaukee, where they died the same day. Mr. Fortney was 33 years old, and had been in the employ of the Landis Tool Co. since 1918, having been Chicago representative since 1922. Mr. Barrie entered the employ of the Allis-Chalmers Mfg. Co. as a machinist in December, 1903. He became a foreman in 1906, was placed in charge of the piece-work and efficiency department in 1912, and appointed superintendent of the maintenance department in April, 1920. He learned the trade of machinist in Manitowoc, Wis., and prior to entering the Allis-Chalmers employ, worked for several years as a machinist in the shops of the Nordberg Mfg. Co. He was fifty-one years old.

MACHINERY EXHIBITION BUILDING AT THE LEIPZIG FAIR

The accompanying illustration shows the machinery exhibition building of the Verein Deutscher Werkzeugmaschinen Fabriken (Association of German Machine Tool Builders) at Leipzig, which housed the machinery section of the Leipzig Fair this fall. This is the largest machinery exhibition building on the European Continent, and possibly the largest building devoted exclusively to machinery exhibits in the world.



Machinery Exhibition Building of the Association of German Machine Tool Builders at the Leipzig Fair

* * *

"NICHROME" IN CAST IRON

Because of the irregularity of the castings, the numerous cores required, and the necessity for sound castings, gray iron with a high silicon content has been the best cast iron available to the automotive industry. Attempts have been made to alloy this metal in such a way that the strength and hardness would be increased, but considerable difficulty has been experienced in obtaining uniform results. Nickel has been added to the cupola with success, but in the case of automotive castings, where a large quantity of silicon is present, the nickel has combined with the silicon in forming large flakes of graphite, which, of course, softens the product. To offset this, chromium has also been added, but it has been uncertain just what the chromium content of the poured mixture should be, as a considerable amount of the chromium oxidizes.

After experimenting along this line, the Driver-Harris Co., Harrison, N. J., has brought out a "Nichrome," Grade B, which may be added to the ladle to obtain chromium and nickel in definite controllable amounts. The analysis of this "Nichrome" is, approximately: Nickel, 60 per cent; chromium, 12 per cent; and iron, 24 per cent. It is claimed that the process produces castings of closer grain, greater hardness, greater resistance to abrasion, increased durability, improved machineability, and decreased brittleness.

Nichrome-processed iron is suitable for casting internal-combustion engine cylinders; electrical equipment, where a control of the magnetic properties is desired; cast-iron cams; iron castings of thin sections where machineability and durability are factors; electrical resistance grids; pistons; piston-rings; and water, steam, gas, and other valves.

* * *

PERSONALS

A. H. ELLERMAN has joined the staff of the Kansas City office of the Wagner Electric Corporation, St. Louis, Mo.

C. J. PRIEBE is now with the Ross Heater & Mfg. Co., Inc., of Buffalo, N. Y., as a sales engineer in the metropolitan district, with offices at 2 Rector St., New York City.

C. G. WENNERSTROM, formerly of the Allbright-Nell Co. of Chicago, has recently joined the engineering force of the Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill.

CHARLES A. SIMMONS, president of the Simmons Machine Tool Corporation, Albany, N. Y., sailed for Europe on the steamship *Paris* on October 17, for a seven weeks' business trip in England, France, and Germany.

DICK COLLINGS has recently joined the sales force of the Bridgeport Brass Co. to cover the Michigan, Buffalo, Ohio, and Pittsburg territories. He was formerly connected with the American Pin Co. and Ireland & Matthews.

DEAN K. CHADBOURNE has been appointed general manager of the Westinghouse Electric International Co., East Pittsburg, Pa., succeeding E. D. KILBURN, who was recently elected vice-president of the Westinghouse Electric & Mfg. Co.

GEORGE ROBERTS has been appointed representative for Detroit and the adjoining territory, of the Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill., manufacturer of IXL speed reducers and gear products. Mr. Roberts' headquarters will be at 576 Montclair St., Detroit.

EDWARD D. KILBURN, vice-president and general manager of the Westinghouse Electric International Co., and WALTER S. RUGG, general sales manager of the Westinghouse Electric & Mfg. Co., were named vice-presidents of the latter company at a recent meeting of the board of directors in New York City. At the same time RICHARD B. MELLON of Pittsburg was elected a director of the company.

HENRY HAMILTON SEABROOK, Philadelphia district manager of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., was recently given a luncheon at the Manufacturers' Country Club by twenty fellow-executives in honor of his twentieth anniversary as an executive of the company. The occasion also marked the twenty-fifth anniversary of Mr. Seabrook's continuous connection with the Westinghouse organization.

GEORGE E. HUNTER, general superintendent of the Elgin National Watch Co., Elgin, Ill., retired from active business, October 1. Mr. Hunter was born in Waltham, Mass., in 1859, and began to work as an apprentice for the Elgin Co. forty-eight years ago. In 1883 he became assistant superintendent of the watch-making department, in 1888 assistant superintendent in charge of machine design, and since 1903 he has been general superintendent. His father held this position before him, and the joint service of Mr. Hunter and his father as superintendents cover sixty years.

4 Reasons

Why WETMORE Reamers Cut Production Costs

Wetmore Expanding Six-blade Standard Finishing Reamer with arbor integral.

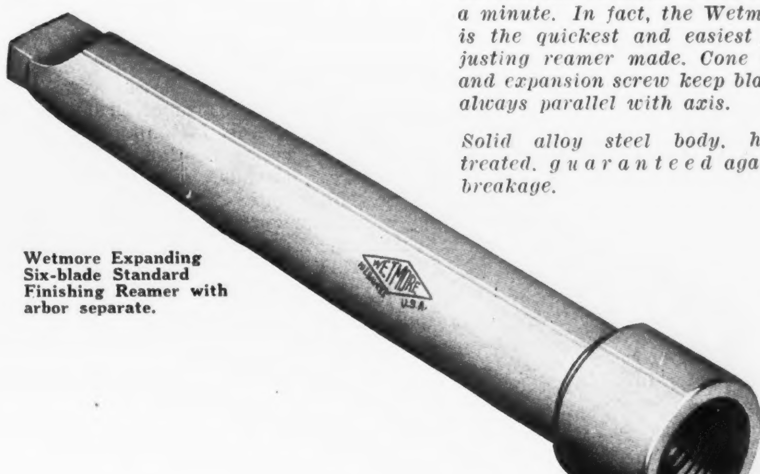
Production men in many of the largest plants are specifying Wetmore Expanding Reamers because Wetmores have proved—on actual tests—that they do *better, more accurate work at less cost.* Here are four features that make Wetmore the reamer preferred by men who know what it can do:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone nut and expansion screw keep blades always parallel with axis.

Solid alloy steel body, heat-treated, guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.



Wetmore Expanding Six-blade Standard Finishing Reamer with arbor separate.

Wetmore Blades are carried in stock for all types of Wetmore Reamers. Best high-speed steel, ground to thickness, length, and on seat. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron, or bronze, etc.

Give a Wetmore Reamer a trial on a good stiff job and compare its work with that of reamers you've been using. You be the judge—and we'll rest our case with you.

Write for catalog of full line of standard, heavy-duty, shell, small machine and cylinder reamers, arbors, replacement blades. Sent FREE—postpaid.

WETMORE REAMER CO.

MILWAUKEE, WISCONSIN

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

TRADE NOTES

Crocker-Wheeler Co., Ampere, N. J., announces that the name of the company has been changed to the Crocker-Wheeler Electric Mfg. Co., effective November 1.

D. H. Luehrs Co., 118 St. Clair Ave., N. E., Cleveland, Ohio, announces that the Carle Machinery Co., Detroit, Mich., will represent the company in the Detroit territory.

Barstow Sales Co., sales agent in the St. Louis territory for Juruick refrigerating machinery, has moved to larger quarters at 3150 Washington Boulevard, St. Louis, Mo.

Union Twist Drill Co., Athol, Mass., has placed the agency for its machine tools, including hob grinders, twist drill point grinders, etc., with Motch & Merryweather of Cleveland, Ohio.

Abrasive Co., Bridesburg, Philadelphia, Pa., manufacturer of grinding wheels and polishing grain, has opened a district office in Detroit at 149 Larned St., East. W. A. MacFarland is in charge of the new office.

Wiley Machine Co., 637 E. Slauson Ave., Los Angeles, Cal., has recently made an addition to its factory building whereby 10,000 additional square feet are available for machine shop work. Dana Wiley is president of the company.

Australian Commonwealth Engineering Standards Association, Macleay House, 16 College St., Sydney, Australia, requests firms in the engineering and allied fields to send the association catalogues and trade publications for its library.

N. A. Strand & Co., 5001 N. Lincoln St., Chicago, Ill., have appointed the E. L. Essley Machinery Co., of Milwaukee, Wis., exclusive distributor of their grinding and polishing machines, flexible shafts, and equipment for the state of Wisconsin.

Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill., have acquired full rights covering the line of horizontal drilling and boring machines manufactured and sold by the Harnischfeger Corporation of Milwaukee for the last twenty-five years.

Tool Equipment Sales Co., 18 S. Clinton St., Chicago, Ill., has been appointed exclusive factory representative of the New Process Twist Drill Co., Taunton, Mass., for the Chicago territory. A complete stock of both carbon and high-speed drills will be carried in the Chicago store.

Brown Instrument Co., 4532 Wayne Ave., Philadelphia, Pa., has opened a Los Angeles branch at 363 New High St., Los Angeles, Cal., with S. F. Godfrey as district manager. A complete repair department for Brown indicating and recording instruments will be maintained at this branch.

Automatic Nut-Thread Corporation, with experimental shop at 24 W. Tupper St., Buffalo, N. Y., has recently placed on the market a new automatic nut-threading attachment for automatic screw machines. The officers of the corporation are Peter H. F. Spies, president; E. N. de Sherbinin, vice-president; and R. B. Webster, secretary-treasurer.

Lincoln Electric Co., Cleveland, Ohio, has made a number of changes in the personnel of its division branches. J. M. Robinson, who was formerly manager of the Grand Rapids office, has been transferred to Detroit. G. W. First has been transferred from the Boston to the Grand Rapids office, and J. E. Durstine goes from the Chicago to the Buffalo office.

Diamond Power Specialty Corporation, of Detroit, Mich., announces that the territory of the Lathrop-Trotter Co., 733 Union Trust Bldg., Cincinnati, Ohio, who have been sales representatives for the Diamond Power Specialty Corporation in the Cincinnati territory for many years, has been extended to take in Indianapolis and the adjacent territory in central and southern Indiana.

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn., has recently made arrangements with Manning, Maxwell & Moore, Inc., to act as sales representatives throughout the United States for the Bridgeport line of grinding and polishing machinery. The Bridgeport Safety Emery Wheel Co. will continue, however, to market direct, its sectional grinding wheel chucks and grinding wheels.

Sloan & Chace Mfg. Co., Ltd., 351 Sixth Ave., Newark, N. J., announces that the business of the company is now being conducted under the name of Sloan & Chace, Inc. The location of the company remains the same. The officers are: President, John V. Rice, Jr.; vice-president and general manager, William F. Smith; treasurer, William M. Morris; and sales and advertising manager, C. S. Pratt.

Cincinnati Planer Co., Cincinnati Bickford Tool Co., Cincinnati Milling Machine Co., Lodge & Shipley Machine Tool Co., and Acme Machine Tool Co. have given the exclusive sale of their lines to the following agents in the South: Woodward, Wight & Co., Ltd., New Orleans, La.; Huey & Philp Hardware Co., Dallas, Tex.; Hausman-Harwick Machine Tool Co., Birmingham, Ala.; and R. S. Armstrong Bro. & Co., Atlanta, Ga.

Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio, has appointed Eicher & Bratt, Seattle, Wash., representative for the sale of E. C. & M. control equipment in the states of Oregon, Washington, Alaska, and the "Pan Handle" district of Idaho. In addition to handling E. C. & M. equipment, Eicher & Bratt also represent the Pittsburg Transformer Co., Jewell Electric Instrument Co., and the Electric Power Equipment Corporation.

Robert June Engineering Management Organization, 8835 Linwood Ave., Detroit, Mich., has acquired control of the Electric Flow Meter Co. at Kansas City, Mo., formerly the Hyperbo-Electric Flow Meter Co. of Chicago, and will henceforth operate the business under its own management. Robert June is president of the company; J. M. Naiman, formerly general manager, is vice-president, consulting and chief engineer; and Major W. W. Burden is treasurer.

Equipment Mfg. Co., 257 Leader-News Building, Cleveland, Ohio, announces that C. G. Kellogg has been put in charge of the sales and development department of the "Craftool" division, which was formerly the Craftsman Tool Co. of Conneaut, Ohio. The Conneaut plant will continue to manufacture the Craftsman continuous rotary milling machines under the name of the Craftool Division of the Equipment Mfg. Co. The company is planning to extend the uses of this machine by the design of special jigs and fixtures.

American Engineering Co., of Philadelphia, Pa., manufacturer of "Lo-Hed" hoists, Taylor stokers, Juruick ammonia compressors, and other machinery, announces that its interests in Canada have been taken over by the Affiliated Engineering Companies, Ltd., with headquarters in the Southam Bldg., Montreal. This company has been organized by the merger of the Taylor Stoker Co., Ltd., of Montreal, and the Cleaton Co., (Canada), Ltd. M. Alpern, president of the American Engineering Co., is chairman of the board, and F. S. B. Heward is president.

American Cable Co., Inc., 105 Hudson St., New York City, has made arrangements with the firm of Bruntons, Musselburgh, to handle its general line, including "Tru-lay" wire rope and "Tru-loc" fittings in Scotland. The Dominion Wire Rope Co., Montreal, Canada, is a new Canadian distributor. Other new distributors are the Marion Machine, Foundry & Supply Co., Marion, Ind.; J. Shuman Hower, 106 Foster Bldg., Utica, N. Y.; Contractors Equipment Co., 8 Steuben St., Albany, N. Y.; and John C. Louis, 221 S. Eutaw St., Baltimore, Md.

Air Reduction Sales Co., 342 Madison Ave., New York City, has created a new sales district with office at 1296 Forest Home Ave., Milwaukee, Wis., following the purchase of the carbide business of the Gas Tank Recharging Co. of Milwaukee. The district manager will be J. S. Strate, who will have charge of the territory comprising parts of Wisconsin, Michigan, Illinois and Iowa within an average radius of about 100 miles. There will be maintained at this new office, in addition to supplies of "Airco" oxygen and acetylene and "Airco-National" carbide, a complete stock of "Airco-D-B" apparatus and supplies.

Chicago Pneumatic Tool Co., 6 E. 44th St., New York City, announces that arrangements have been made with the Motoren-Werke, Mannheim, Germany, for the exclusive rights to manufacture and sell the Benz solid injection Diesel engine in the United States and Canada. The advantages claimed for the Benz engine, among others, are its simple design, which eliminates the use of a high-pressure compressor, an injection cylinder with high-pressure pipe line, and injection valve; neither is an ignition device required. The Benz engine operates on any kind of petroleum or its derivatives, such as gas oil, kerosene, crude oil, paraffin oil, or lignite tar.

Buhr Machine Tool Co. has been organized at Ann Arbor, Mich., to take over the business, including the good will and patents, of the J. F. Buhr Machine Tool Co., which was the outcome of the Nelson-Blanck Mfg. Co. The company will manufacture the Buhr multiple drillers and tappers originally made by the Nelson-Blanck Mfg. Co., and for the last year and a half manufactured by the Blodgett Engineering & Tool Co. under contract with J. F. Buhr. The new company has bought the Forge Products Plant in Ann Arbor, and has installed equipment for the manufacture of these machines. The officers are: President and general manager, Joseph F. Buhr; vice-president, Julius F. Haarer; secretary, Edward F. Bauer; and treasurer, Fred T. Stowe.

Upsetting 40 Cylinder Ends per Hour

This 5″ Ajax Upsetting Forging Machine at the plant of R. Hoe & Company, New York City, forms cylinder ends 4½″ in diameter and 2½″ thick on the end of 2″ bars at the rate of 40 per hour. One operator, doing both heating and operating, maintains this production throughout the 40-hour working week.

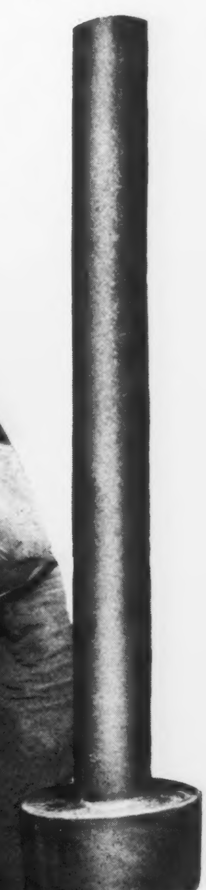
Hoe Printing Presses are an eminent example of mechanical perfection, the result of carefully worked out production methods and exact specifications. The four Ajax Machines at their plant, both in production and quality of product, measure up to these Hoe methods and Hoe specifications.

The Ajax Manufacturing Co.

Euclid, Ohio

CHICAGO, ILL.
621 Marquette Building

NEW YORK CITY
1369 Hudson Terminal



Photographed at
R. Hoe & Co.,
New York City

AJAX

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COMING EVENTS

NOVEMBER 9-10—Service engineering meeting of the Society of Automotive Engineers, at the LaSalle Hotel, Chicago, Ill. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NOVEMBER 14-15—Automotive transportation meeting to be held in Philadelphia, Pa., by the Society of Automotive Engineers. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

NOVEMBER 30–DECEMBER 3—Ninth annual industrial safety congress and exhibition under the auspices of the New York State Department of Labor, to be held at Syracuse, N. Y.; headquarters, Hotel Onondaga. Further information may be obtained by addressing State Department of Labor, 124 E. 28th St., New York City.

NOVEMBER 30–DECEMBER 4—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary.

NOVEMBER 30–DECEMBER 5—Fourth national exposition of power and mechanical engineering to be held in the Grand Central Palace, New York City.

JANUARY 9-16—National Automobile Show to be held at the Grand Central Palace, New York City.

JANUARY 11-13—Second World Motor Transport Congress to be held in New York City during the National Automobile Show. Sponsored by the National Automobile Chamber of Commerce, 366 Madison Ave., New York City.

JANUARY 20-22—Annual meeting of the Society of Automotive Engineers to be held in Detroit, Mich. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

JANUARY 21-22—Winter sectional meeting of the American Society for Steel Treating at Buffalo, N. Y. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

JANUARY 30-FEBRUARY 6—National Automobile Show, to be held at the Coliseum, Chicago, Ill.

NEW BOOKS AND PAMPHLETS

AN INVESTIGATION OF THE EFFICIENCY AND DURABILITY OF SPUR GEARS. By C. W. Ham and J. W. Huckert. 94 pages, 6 by 9 inches. Published by the University of Illinois as Bulletin No. 149 of the Engineering Experiment Station. Price, 50 cents.

EFFECT OF WEAR ON THE MAGNETIC PROPERTIES AND TENSILE STRENGTH OF STEEL WIRE. By Raymond L. Sanford, Walter L. Cheney, and James M. Barry. 6 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 510 of the Bureau of Standards. Price, 5 cents.

A. S. T. M. STANDARDS ADOPTED IN 1925. 117 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Price, $1.50.

This pamphlet comprises the first supplement to the 1924 book of A. S. T. M. Standards, and contains thirty-six revised or newly adopted standards of the society.

A GRAPHIC TABLE COMBINING LOGARITHMS AND ANTI-LOGARITHMS. By Adrien Lacroix and Charles L. Ragot. 64 pages, 7 by 10 inches. Published by the Macmillan Co., 60 Fifth Ave., New York City. Price, $1.40.

This book contains a table giving directly, without interpolation, in one graphic scale the logarithms to five places of all five-place numbers, and the numbers to five places corresponding to all five-place logarithms. The five-place table of 40 pages is followed by a 6-page table covering all four-place numbers and logarithms. The table is unusually complete. It gives all of the 100,000 logarithms and 90,000 numbers without the necessity of interpolation.

DRAFTING METHODS. By Douglas S. Trowbridge. 154 pages, 5½ x 8½ inches. Published by the Codex Book Co., Inc., 461 Eighth Ave., New York City. Price, $2.50.

The aim in publishing this book is to present kinks or suggestions relating to drafting methods that will simplify and ease the draftsman's labors. The book is the result of many years of research and personal experience on the part of the author and embodies suggestions from many other engineers. The text is divided into eight chapters dealing with the following subjects: Drawing Instruments; Use of Instruments; Lettering; Symbols and Abbreviations; Filing Methods for the Draftsman; Instrument Kinks; Drafting Kinks; and Nevers and Don'ts.

SPECIAL LIBRARIES DIRECTORY. 254 pages, 6 by 9 inches. Published by the Special Libraries Association, 195 Broadway, New York City. Price, $4.

This is the second edition of a national directory of business and technical libraries of the United States. The directory describes each special library and lists all according to the general subjects covered. The survey shows a total of 975 libraries, of which almost 400 are largely or wholly concerned with industrial subjects. Besides the classified list, a geographic index, a title index, a personnel index, and a subject index are included. Among the subjects covered are accounting, advertising, aeronautics, agriculture, automobiles, banking, building, business organization, credit, financing, housing, industrial management, machinery and equipment, metallurgy, personnel administration, prices, railroads, salesmanship, statistics, and taxation.

MATERIALS TESTING. By Irving H. Cowdrey and Ralph G. Adams. 129 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $1.50.

In this work on materials testing, the authors have attempted in most instances to be general rather than highly specific. The book is intended to serve as a text in connection with laboratory courses in the study of materials under stress. No attempt has been made to outline in detail any particular set of tests or experiments, but rather to acquaint the reader with the general principles upon which the great mass of specifications are based. The material is divided into seventeen parts dealing with the following subjects: Province of the Testing Engineer; the Report; Testing Machines; Tensile Tests; Graphs; Compressive Tests; Torsional Tests; Transverse Tests; Dynamic Tests; Test Specimens and Holders; Fractures and their Significance; Hardness Determination; Cement Testing; Testing of Sand; Timber Testing; Measuring Devices; and Verification of Testing Machines.

NATIONAL DIRECTORY OF COMMODITY SPECIFICATIONS. 379 pages, 7½ by 11 inches. Published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 65 of the Bureau of Standards. Obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, $1.25.

This is the first attempt on the part of the Department of Commerce to collect and publish a classified list of existing commodity specifications, formulated not only by public purchasers throughout the United States, but also by the nationally recognized trade associations, technical societies, and public utilities. It contains an alphabetical list of commodities, as well as a classified list of specifications for all types of commodities. The book covers over 6000 commodities, which are divided into ten classes ranging from animal products to machinery and vehicles. It tells what specifications are in general use, by whom they were prepared, and where copies can be obtained. It covers about 27,000 specifications.

NEW CATALOGUES AND CIRCULARS

CONVEYORS. Cecil R. Lambert Co., 3451 Denton St., Detroit, Mich. Publication devoted to material handling and conveyor applications.

ELECTRIC DRILLS. Hisey-Wolf Machine Co., Cincinati, Ohio. Bulletin 108, illustrating and describing a new Hisey ⅝-inch capacity standard-duty universal electric drill.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Loose-leaf circular 169 FE, illustrating the application of New Departure ball bearings in a speed-reducing unit.

TURRET LATHES. Foster Machine Co., Elkhart, Ind. Blueprint and photograph, illustrating the savings effected in machining a differential housing on a Foster turret lathe equipped with suitable tooling.

ELECTRIC TACHOMETERS. Brown Instrument Co., 4532 Wayne Ave., Philadelphia, Pa. Catalogue 44, illustrating and describing Brown indicating and recording tachometers for measuring revolutions per minute.

CHUCKS. Foster Machine Co., Elkhart, Ind. Circular descriptive of how the use of a Foster-Barker special automatic indexing chuck increased production in machining brass tees and ells on a Foster screw machine.

DIAL COMPARATOR. B. C. Ames Co., Waltham, Mass. Bulletin 201, describing the construction and application of the Ames dial comparator, which is used for comparing sizes of pieces, in quantity, with established standards.

PUNCHING AND SHEARING ATTACHMENTS. Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular showing a large number of attachments designed by the company for punching and shearing a wide variety of work.

SPEED REDUCERS. Philadelphia Gear Works, Richmond and Tioga Sts., Philadelphia, Pa. Bulletin 10-25, descriptive of the worm-gear and spur-gear speed reducers made by this concern. Copies will be sent to those interested, upon request.

WIRE-FORMING MACHINES. Baird Machine Co., Bridgeport, Conn. Catalogue illustrating some of the Baird products, including wire and ribbon metal forming machines, bench power presses, tumbling barrels, and the Baird horizontal chucking machine.

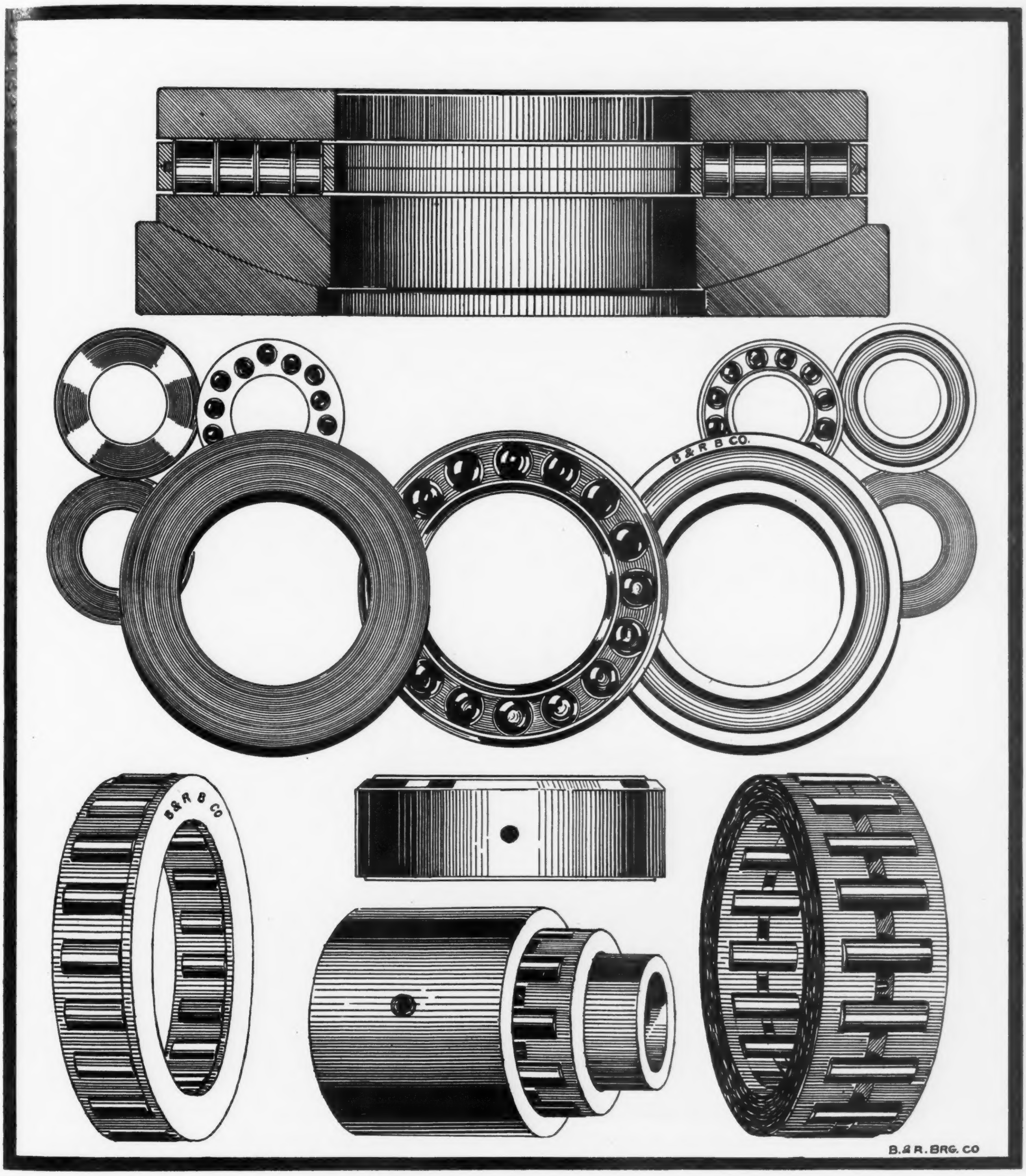
ELECTRIC SCREWDRIVERS. United States Electrical Tool Co, Cincinnati, Ohio. Booklet descriptive of the United States portable electric screw-, nut-, and stud-driver. The capacities of the different models are shown graphically by a chart, and charts of pilot hole sizes are included.

STOP-WATCHES. O. Zernickow Co., 15 Park Row, New York City. Circular illustrating and describing the O-Z laboratory timer stop-watch for use in scientific laboratories, technical colleges, etc., where testing and calibrating, and time and motion studies are carried out.

GAS REGULATORS. Alexander Milburn Co., 1416 W. Baltimore St., Baltimore, Md. Bulletin 200-A, descriptive of the Milburn standard type R 3-inch oxygen or "high-pressure" regulator, designed to insure accurate gas delivery. Those interested can obtain copies upon request.

HARDNESS TESTING. Edward G. Herbert, Ltd., Levenshulme, Manchester, England. (American agent, Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa.) Monthly periodical entitled "The Pendulum," dealing with the hardness of materials and devices for testing hardness.

SILENT CHAIN DRIVES. Morse Chain Co., Ithaca, N. Y. Circular announcing the Morse Chain Co.'s exhibit of silent chain drives at the Power Show, Grand Central Palace, New York City, November 30 to December 5. The circular also shows examples of various applications of Morse silent chain drives.



When equipping your machines with ball and roller bearings, use the best. They cost no more. Our superior bearings have been the standard for years.

Send for our catalog No. 10.

THE BALL & ROLLER BEARING CO.
Danbury, Connecticut, U. S. A.

MATERIAL HANDLING EQUIPMENT. Stephens-Adamson Mfg. Co., Aurora, Ill., is publishing a periodical called "The Labor Saver," which is devoted to descriptions of material handling equipment, including belt conveyors, chains, shovels, bucket elevators, etc., and applications in different industries.

DRILLING AND TAPPING MACHINES. Luehrs Co., 118 St. Clair Ave., N. E., Cleveland, Ohio. Bulletin illustrating and describing the Luehrs automatic high-speed drilling and tapping machine, which is designed to handle drilling, counterboring, tapping, reaming, and milling operations required on small-production parts.

TOOL STEELS. Firth-Sterling Steel Co., McKeesport, Pa. Catalogue of steels, and handbook for the purchasing agent, the steel treater, and user. The book covers the various grades of Firth-Sterling steel, describing heat-treatments, and giving the uses for which each grade is especially applicable, and other commercial data.

BENCH MICROMETER. Societe Genevoise d'Instruments de Physique, Geneva, Switzerland. (R. Y. Ferner Co., Investment Bldg., Washington, D. C., American agents.) Circular 298-A, illustrating and describing a high-precision bench micrometer of 4 inches capacity, reading to 0.00001 inch and accurate to 0.00005 inch.

CONSTRUCTION ENGINEERING. Austin Co., Cleveland, Ohio. Catalogue entitled "The Austin Book of Buildings," showing a large number of examples of industrial and commercial buildings erected by this company. The catalogue is also intended to serve as a reference book of building data for executives in charge of building projects.

SCREW-CUTTING LATHES. Societe Genevoise d'Instruments de Physique, Geneva, Switzerland. (R. Y. Ferner Co., Investment Bldg., Washington, D. C., American agents.) Catalogue 417, entitled, "High-precision Screw-cutting Lathes," describing five sizes of lathes of high precision, for cutting micrometer screws, lead-screws, thread gages, etc.

HYDRAULIC MACHINERY. R. D. Wood & Co., Philadelphia, Pa. Catalogue illustrating and describing types of hydraulic machinery applicable to the metal and rubber industries, including flanging, plate-bending, drawing, forming, forging, and straightening presses, bulldozers, shears, punches, riveters, steam platen presses, hydraulic pumps, valves, etc.

HARDNESS TESTERS. Wilson-Maeulen Co., 383 Concord Ave., New York City. Pamphlet describing the construction and application of the Rockwell direct-reading hardness tester for use on all metals of any shape. The instrument is equally applicable to precision work in the laboratory and quantity inspection testing in the shop. Sizes and prices of the various models are included.

ELECTRIC MOTORS AND OTHER ELECTRIC EQUIPMENT. Holtzer-Cabot Electric Co., Boston, Mass., has published a handsome catalogue in celebration of the fiftieth anniversary of the company, which was founded in 1875. The book contains a historical sketch of the company and illustrations of the personnel, as well as views of the various electric devices made by the company.

MULTIPLE-SPINDLE AUTOMATICS. Cleveland Automatic Machine Co., Cleveland, Ohio. Treatise No. 9, describing in detail the construction of Cleveland model M multiple-spindle automatics. A specification summary of the different sizes is included, as well as floor and countershaft plans and data charts. Various examples of work handled on these machines are illustrated.

THREADING DIES. Jones & Lamson Machine Co., Springfield, Vt. Pamphlet illustrating and describing Hartness automatic threading dies, which are equipped with high-speed chasers, ground and lapped in the thread. The construction of these dies is described in detail, and a list of the types and sizes is given. The chaser grinding jig supplied with each Hartness diehead is also illustrated.

ANGULAR-HOLE DRILLS. Watts Bros. Tool Works, 760-70 Airbrake Ave., Wilmerding, Pa. Catalogue 8, entitled "How to Drill Square, Hexagon, Octagon, Pentagon and Triangular Holes," describing the Watts' method of drilling angular holes, and the full-floating chucks and drills made by this company for use in drill presses, hand screw machines, engine lathes, turret lathes, and milling machines, for the production of angular holes.

TOOL STEELS. Vanadium Alloys Steel Co., Latrobe, Pa., is distributing a wall chart, 12 by 18 inches in size, describing the various brands of "Vasco" tool steels, the purpose for which each grade is especially adapted, the proper heat-treatment, etc. These charts will be sent to tool-room foremen, master blacksmiths, purchasing agents, and other mechanical executives interested in tool steels.

AUTOMATIC TEMPERATURE CONTROL INSTRUMENTS. Brown Instrument Co., 4532 Wayne Ave., Philadelphia, Pa. Catalogue 87, treating of the subject of automatic temperature control, and illustrating indicating, signalling, recording, and alarm instruments manufactured by this company. The catalogue also shows a number of applications of the various instruments on different classes of work.

AUTOMATIC SHAPE-CUTTING MACHINES. Automatic Cutting Machine Co., 66 Brookline Ave., Boston, Mass. Circular descriptive of automatic shape-cutting machines on which work is cut to the desired shape by torches. These machines are especially applicable for large work such as locomotive frames. The circular illustrates a number of examples of parts cut on these machines.

SMALL TOOLS. Greenfield Tap & Die Corporation, Greenfield, Mass. Catalogue 49, covering the line of small tools made by this concern, including screw plates, ground-thread taps, spiral-fluted staybolt taps, dies, twist drills, reamers, screw-slotting cutters, gages, pipe tools, and bolt and pipe threading machines. A special method of packing screw plates for the domestic trade is described on page 13.

SAWS. Henry Disston & Sons, Inc., Philadelphia, Pa. Pamphlet entitled "How a Disston Hand Saw is Made," which tells the story of the manufacture of the saws from the making of the special steel which is used, through the various processes of rolling, trimming the blanks, cutting the blanks, cutting the teeth, hardening, tempering, grinding, tensioning, finishing, setting the teeth, and sharpening.

NUT-THREADING ATTACHMENT. Automatic Nut-Thread Corporation, 24 W. Tupper St., Buffalo, N. Y. Circular announcing a new universal automatic nut-threading attachment which is made for application to Brown & Sharpe automatic screw machines, in three sizes—00, 0, and 2. These attachments will also be made for application to various other makes of screw machines. By their use the tapping can be done simultaneously with the forming of the nut blank.

TAPS. John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. Ground Thread Handbook (catalogue 10) containing information on the origin and application of the ground thread; how Bath taps are ground from the "solid"; and ground thread tolerances. This section is followed by a catalogue of Bath taps, thread gages, and dies. The third section of the book contains hints on tapping, tables of tolerances, pipe standards, tap drill sizes, dimensions of hand taps, etc.

ELECTRIC WELDING. American Electric Fusion Corporation, 2610 Diversey Ave., Chicago, Ill., is distributing a monthly publication entitled "A. E. F. Welding Illustrated," with the object of promoting knowledge of electric welding, reducing costs of manufacturing, and increasing quality. The September number of this publication describes the construction of the electric spot welding machine made by this concern, and contains illustrations of the plant and information about the organization.

BALL BEARINGS. Fafnir Bearing Co., New Britain, Conn. General catalogue 26, covering industrial and textile applications of Fafnir ball bearings. The book is illustrated with photographs of actual installations, and contains considerable general information on the principles of ball bearing transmission equipment, being more in the nature of a handbook on the subject, than a mere catalogue. Complete dimensions and prices of Fafnir ball bearings are given, superseding those given in previous catalogues.

SPEED REDUCERS. Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill. Catalogue 26, covering the Foote Bros. line of IXL speed reducers. This is a revised edition of the catalogue, and contains additional engineering information pertaining to the solution of problems involving spur and worm gear speed reducers. Illustrations, tables, formulas, practical problems, and general information on the subject of transmission gearing and speed reduction problems are included. Copies of this catalogue will be sent to those interested, upon request.

TWIST DRILLS, REAMERS, MILLING CUTTERS, TAPS, DIES. Morse Twist Drill & Machine Co., New Bedford, Mass. Set of descriptive folders covering, respectively, the new Morse bit for wood; Morse combined drill and countersink; No. 392 wood drills for brace; Morse radio set No. 3; Morse tools, including drills, reamers, taps, keyway cutters, and drill chucks; and Morse adjustable reamers. The company also issues a booklet entitled "Machinist's Practical Guide," containing a variety of tabular matter of value to those interested in small tools, such as tables of Morse tapers, speed and feed tables for drills, decimal equivalents, thread tables, etc.

ANNUAL MEETING OF MECHANICAL ENGINEERS

The annual meeting of the American Society of Mechanical Engineers will be held November 30 to December 4 in the Engineering Societies Building, 29 W. 39th St., New York City. Over forty papers will be presented at the meeting. One of the features of the meeting will be the presentation of honorary membership in the society to Secretary Herbert Hoover and to Worcester R. Warner, past president of the society. This event will occur on Tuesday evening, December 1, preceding the presidential address by Dr. William F. Durand. On Tuesday afternoon, December 1, at 4:30 P. M., Hon. Herbert Hoover will deliver the first Henry R. Towne lecture on the relation of engineering and economics. On Thursday afternoon, December 3, at 4:30 P. M., the Robert Henry Thurston lecture on the relation of engineering and science will be given.

There will be five sessions relating to machine shop practice and machine design. The topics to be discussed include belt transmission, optical measurement, gears, machine tool design, spring design, lubrication, torsional stresses in shafts, and vibrations in shafts. In addition, there will be two sessions devoted to management, and sessions covering fuel and power, textile machinery, motor applications in the textile industry, materials handling, and aeronautics.